UNIVERSITY OF
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Understanding Human Perception of Primate Facial Expressions and its Impacts on Human-nonhuman Primate Interactions.

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Laura Clark

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Abstract

During wildlife tourism encounters, humans are sensitive to the expressions of non-human primates and often apply inferred felt emotions to them, to provide the interaction with context of how the animal may behave. This can influence how the human may behave towards the animal and an inappropriate interaction can often result in unwanted aggression. This study aims to reduce the amount of unsafe wildlife tourism interactions by exploring if and how human perception of non-human primate facial expressions influences approach behaviour. Using images of Barbary macaques and Capuchin monkeys, two complementary studies were carried out. One focusing on the developmental progression of the human perception of Barbary macaque facial expression and the second exploring different levels of exposure and experience on human perception of and behaviour towards Capuchins in UK and Argentinian natives.

For the first study, 81 children and 103 adults were recruited. This study aimed to assess (1) whether human accuracy of facial expression perception is determined by the species perceived (i.e. human and Barbary macaque), type of expression, age, gender, intergenerational effects or behaviour towards animals; (2) whether age, gender and human perception of Barbary macaque facial expressions will influence participant intended proximity to approach, feed or take a selfie with the macaques; (3) If human self-reported behaviour will accurately represent simulated real-life perception of and behaviour towards Barbary macaques. Human perception of Barbary macaque facial expressions did not improve with age as found with human facial expressions, but only improved depending on the type of expression. Participants were more able to accurately perceive neutral, friendly and very aggressive macaque facial expressions than aggressive and distressed ones. No significant differences between the questionnaire and practical task were found for participant ability to accurately perceive distressed, neutral, aggressive or very aggressive Barbary macaque facial expressions.

For the second study, a total of 111 participants were recruited. This study aimed to assess (1) whether human accuracy of capuchin facial expression perception is determined by exposure via country of residence, gender or type of capuchin facial expression; (2) whether exposure via country of residence, gender, age and type of expression will influence human intended approach, feed or take a

selfie with the capuchins; (3) how perception of and behaviour towards a capuchin will differ between a face only image and face and body image, and how participant experience with capuchins affects this. Argentinians who were novices with respect to encountering capuchins were more accurate in their perception of aggressive capuchin expressions compared to UK novice participants. Argentinian novice participants approached neutral and distressed capuchins closer than UK participants. Both naïve and capuchin-exposed participants were more accurate in their capuchin facial expression recognition when viewing the full face and body image compared to a face only image.

Both studies also showed that young males are at greater risk of unsafe human-animal interactions due to their close approaching behaviour and preference for aggressive expressions. The findings from this research can be utilised to make wildlife tourism safer for all ages whilst informing interspecies communication research.

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Chapter 1

1.1. General Introduction

In humans, adaptive and meaningful facial movements, termed facial expressions, are used to portray their emotional state (Adolphs, 2002). A similar form of nonverbal social communication is also present among non-human primates (hereafter primates) (Tate, Fischer, Leigh & Kendrick, 2006). However, felt emotion and expression are rarely assumed to be the same in humans as it is in animals (de Waal, 2011). Animal 'emotion' is typically seen instead as more of a process that facilitates appropriate responses to a wide range of social contexts (Parr & Waller, 2007; Waller & Micheletta, 2013). Humans are not only sensitive to the expressions of emotions in other humans, but they also pay attention to the facial expressions of non-conspecifics, such as dogs and primates applying their interpretation of the laws of emotion to them (Kujala, Somppi, Jokela, Vainio & Parkkonen, 2017). Thus, as non-expert human observers have a tendency to anthropomorphise animal expressions, potentially leading to dangerous interactions, this study is interested in the human perception of primate facial expressions. This study also aims to understand if and how human perception of primate facial expressions influences approach behaviour and to analyse this in terms of development and experience; to ultimately answer the question of what influences human and animal tourist interactions.

Interspecies communication, between humans and non-human animals (hereafter animals), is highly reliant on facial cues to interpret the motivations of the animals involved. In humans, the ability to categorise emotions based on other humans' facial expressions differ with age and across emotions, with difficulty increasing from happiness, sadness and anger, to fear and disgust, to neutral emotional states (Durand et al., 2007). Similarly, in dog expressions, participants showed more correct answers with increasing age and improved after intervention (Meints, Racca, & Hickey, 2010; Meints, Brelsford & Keuster, 2018).

The effect of age on humans' ability to perceive primate facial expression has not yet been researched and I propose to do so from a developmental standpoint. The effect of experience has been researched to find that experienced participants who have worked with macaques performed better than exposed and naïve participants at assessing their facial expressions (Maréchal, Levy, Meints & Majolo,

2017). Therefore, age and experience are two key factors which may influence the human ability to correctly interpret an animal's expression and consequently influence their behaviour and interaction with the animal - this will be explored further in this study. A greater understanding in this area of human-animal interactions is needed to help promote safer interactions in wildlife tourism.

Domestic dogs (*Canis familiaris*) are one of the most frequently studied non-human animals in facial expression research. Despite the long domestication of dogs with humans and their social communication skills (Grimm, 2015), research suggests that both children and adults are uninformed of and often misinterpret dog facial and body signalling (Meints et al., 2018). Young children especially confuse very angry dogs as being friendly and therefore approachable. Such misinterpretation can lead to resulting inappropriate behaviour by the human and may induce a stress reaction in the dog (Meints et al., 2018; Meints et al., 2010). Furthermore, children and adults often do not notice stress signalling in dogs such as nose licking and turning away, they can easily ignore or misinterpret them which can heighten the risk and can cause the dog to resort to using other strategies such as aggression (Meints et al., 2018). This research also concluded that whilst adults performed better than children, dog owners were no better than non-owners.

Similar to research on dogs, tourists fail to identify aggressive and distressed expressions in wild primates, in particular macaques, mistaking the warning signs such as an open mouth and protruding lips for 'smiles' and 'kisses', this can also lead to aggression and risk of injury (Maréchal et al., 2017). Human behaviour towards primates, in particular macaques and capuchins, has seen little attention, even though the World Health Organisation (2020) found monkey bites to be the second most common bite risk to travellers after dog bites. Due to the ever-increasing popularity of wildlife tourism, more research to explain and improve risky tourist behaviour is needed.

In terms of tourist behaviour, it has been found that humans use morphological clues to approach macaques they perceive to be trustworthy, subordinate, cute, social, young and female, similar to traits they look for when approaching humans (Clark, Butler, Ritchie & Maréchal, 2020). Tourists can cause a stressful situation for primates by crowding them, waving objects at them or chasing and attacking them (Maréchal, MacLarnon, Majolo & Semple, 2016). Too much stress in macaques can impede reproduction rates which is harmful to the population

(Maréchal et al., 2011). The primates will react to the stressful situations also by using coping mechanisms such as avoidance behaviour (Stankowich & Blumstein, 2005), social behaviour e.g. buffering (Kikusui, Winslow & Mori, 2006), direct aggression (Kazem & Aureli, 2005) and displacement behaviour, e.g. self-scratching (Anselme, 2008). Whilst coping mechanisms are supposed to diffuse the stressful situation in a positive way both the methods of aggression and displacement have the potential to cause physical harm to the primate themselves and the tourist.

In field sites, dominant macaques seek out interactions with tourists at unsafe distances (Clark et al., 2020) and aggression from macaques can lead to tourists being bitten or scratched (Beisner et al., 2015) which can increase the chance of pathogenic transfer (Fuentes, 2006; Carne, Semple, MacLarnon, Majolo, & Maréchal, 2017). Animal bites are an increasing risk to wildlife tourists, especially children (Bréhin et al., 2016).

One of the aims of this research was to attempt to understand and reduce these aggressive and harmful interactions, by studying two species of primates popular to tourist sites. Firstly, Barbary macaques (*Macaca sylvanus*) who are located in popular tourist sites such as Gibraltar (Majolo et al., 2013, Fuentes, 2006; Fa, 1984) and Morocco (Maréchal et al., 2011; Fa, Taub, Menard & Stewart, 1984), and secondly, a wild group of black capuchin primates (*Sapajus nigritus*) visited by tourists at Iguazú National Park, Argentina (Tiddi, Pfoh & Agostini, 2019).

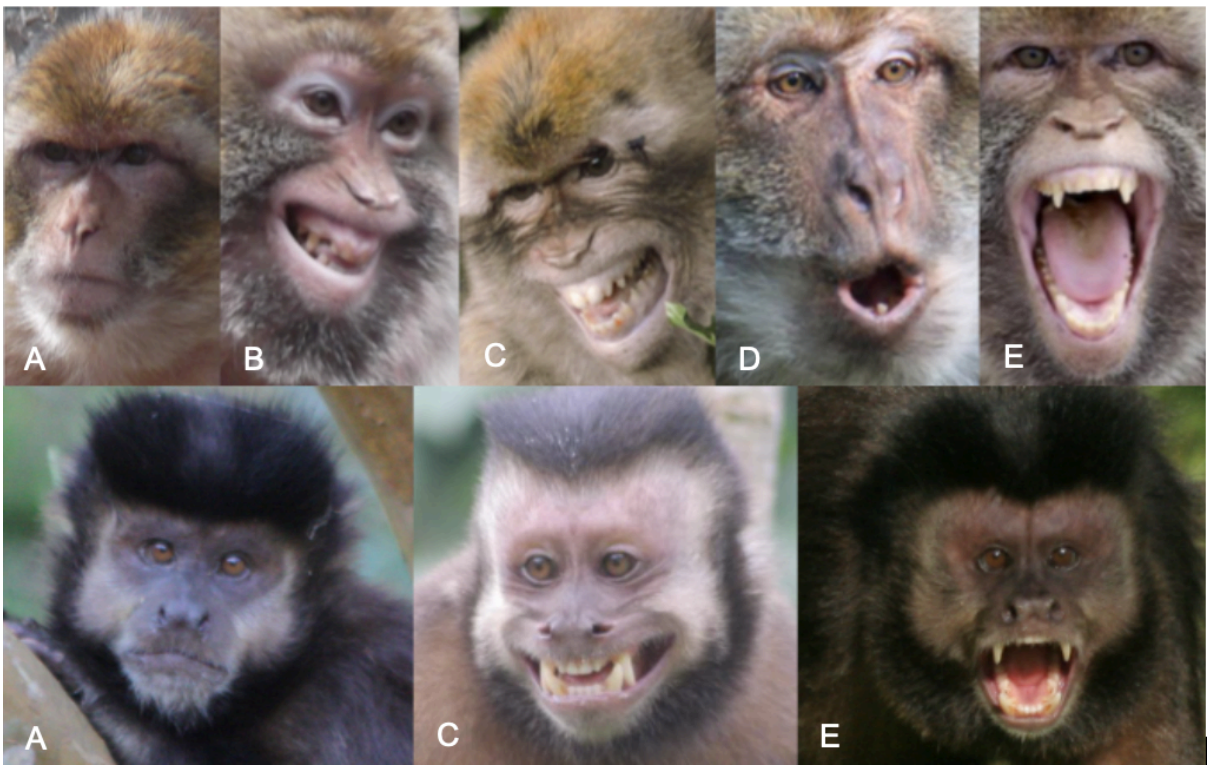
To explore these two species and the effect that human perception of their facial expressions has on human behaviour, two complementary studies were proposed. The first focused on the developmental progression of human facial expression perception across the lifespan, for both human and Barbary macaque faces and aimed to answer how human children perceive macaque facial expressions and how this differs to adults.

The second, a cross-cultural study, explored the differences that levels of exposure and experience have on human perception of capuchin facial expressions, using UK and Argentinian natives including a group of capuchin experts. This second study aimed to assess the effect that three different levels of human exposure to capuchins have on the ability to perceive capuchin facial expressions.

Both studies utilised primate images displaying either friendly, neutral, distressed, aggressive and very aggressive expressions, with study 2 only using three of the expression categories (Figure 1).

Figure 1.

Examples of the chosen expressions



Note: The top row shows Barbary macaques, the bottom row shows the capuchins with explanations of each expression below (Maréchal et al., 2017; Bowler & Whiten, 2015; Van Hooff, 1997) (©2020 Dr. Laëtitia Maréchal, Prof. Julia Fisher, Andrew Forsyth, Barbara Tiddi and Brandon Wheeler):

A. Neutral: closed mouth and overall relaxed face (macaque and capuchin).
B. Friendly / affiliative: relaxed half open mouth and slightly protruding lips (macaque).
C. Distressed: corners of the lips retracted with upper and lower teeth showing (macaque). Open mouth grin with teeth displayed and flattened ears (capuchin).
D. Aggressive: raised eyebrows with protruding lips and round mouth (macaque).
E. Very aggressive / threat face: raised eyebrows open mouth with teeth showing (macaque). Eyebrows, fur and tail raised, fixed stare and open mouth (capuchin)

Both of the two studies will measure behaviour on a physical scale of distance and use a multiple-choice option of facial expression categorisation using the options of happy, okay, scared or angry. Therefore, both will aim to answer the question as to how facial expression perception of a primate affects human behaviour towards them. The two studies will also test different methods of research into the human perception of primates, which typically relies on a photographic image of the animal's isolated face displayed on a computer (Clark et al, 2020; Maréchal et al, 2017). To

improve ecological validity, this study not only tests the traditional photo-based 'face only' stimuli but study 1 will also compare with physical life size stimuli, whilst study 2 will also compare with photo-based full body stimuli. These studies as a whole aim to explore the context in which primate facial expressions are inferred and perceived and how this affects human behaviour towards them.

Chapter 2

Understanding Human Perception of Primate Facial Expressions and its Impacts on Human-nonhuman Primate Interactions: A Developmental Approach

2.1. Introduction

Facial expressions are important nonverbal communicative cues in face to face interactions (Chibelushi & Bourel, 2004). They convey a variety of information about an individual's motivations, intentions and emotions; therefore, they are very important for coordinating social interactions and relationships (Parr, Preuschoft & de Waal, 2002). Facial expressions are not only produced and utilised by humans as a form of communication within species, but also by some mammals, including primates (Parr, Waller, Burrows, Gothard & Vick, 2010), albeit to varying extent. Little is known about how facial expressions act as a form of communication between species, and how such ability develops from childhood. Using Barbary macaque and human images, this study investigated how varying facial expressions in the animal influence human perception of and behaviour towards them. Investigating this across the lifespan will add to existing knowledge surrounding child development and interspecies communication, useful to the wildlife tourism industry to prevent any harmful interactions. This introduction will explore the development of facial expression recognition abilities in humans, contributing factors and how this perception affects behaviour.

Recognition of human facial expression

The human ability to recognise human facial expressions develops gradually throughout childhood (Batty & Taylor, 2006). More specifically, by the age of 5, children have near adult-like ability to recognise happy facial expressions in other

humans (Gao & Maurer, 2010). As children age, between 8-11 years, angry and happy expressions are the most recognised, followed by neutral expressions, with expressions of fear being significantly less recognised (Mancini, Agnoli, Baldaro, Ricci Bitti & Surcinelli, 2013). Facial expression recognition reaches its peak in young to middle-aged adults and can also begin to decline with age when comparing older adults to young adults (Ruffman, Henry, Livingstone & Phillips, 2008). It has been reported that the development of facial expression recognition follows 'an inverted U-shaped trajectory', with young and middle-aged adults being the most accurate when compared to children and older adults (Williams et al., 2009).

One of the main factors in typically developing children, other than age, that may influence their facial expression recall is gender (McClure, 2000). Some argue that both sexes are competent at recognising facial expressions, with studies finding that both males and females perform equally well in emotion recognition tasks (Hall & Matsumoto, 2004; Herba, Landau, Russell, Ecker & Phillips, 2006). However, growing evidence from more recent research has found that females outperform males at all ages (Lawrence, Campbell & Skuse, 2015). This is consistent with the literature on females having superior empathy and emotion recognition abilities (Alaerts, Nackaerts, Meyns, Swinnen & Wenderoth, 2011), and by males finding it harder to distinguish one emotion from another (Thayer & Johnsen, 2000).

The development of human understanding of their own species' facial expressions is shown to develop gradually with age, potentially influenced by a person's gender. However, the development of human understanding of facial expressions in other species, such as primates, is far less explored. Being able to understand the human ability to perceive expressions of another species they are not regularly exposed to or have experience with, will also provide useful insight into the development of facial expressions as a whole.

Recognition of Non-Human Animal facial expression

One of the only studies to test a child's perception of a primate's facial expression comes from Amici, Waterman, Kellerman, Karimullah and Bräuer (2019). They report that children overall performed poorly in their recognition of chimpanzee expressions and that they correctly recognised angry, fearful and happy chimpanzee facial expressions less frequently than they could recognise those expressions in dogs and humans. However, still greater emphasis on comparing age groups and

individual differences as well as detail about the child's perception, if incorrect, of the expressions is required; which I aim to explore in this study.

Due to the limited research on child and primate interactions; child-inclusive research on other animals, such as dogs, can potentially be applied to child behaviour towards primates. Meints, Racca and Hickey (2010) tested humans' ability to recognise happy, aggressive and neutral dog facial expressions from still images. Their results found that adults were highly accurate, whilst the children had high percentage rates of incorrect expression recall. In particular 78% of 4-year-olds who made mistakes misinterpreted aggressive dog faces as smiling and happy, five-year-olds misinterpreted 35% of the expressions, with 6- and 7-year-olds performing the best, but still showing 25% and 17% misinterpretations. In more recent work, Meints et al. (2018) tested 3-6-year-olds' and adults' ability to interpret dog's expressions and signalling using real-life videos. Again, younger children showed more mistakes than older children and adults, and errors occurred more in "conflict-defusing" than in "conflict escalating" signalling with error rates as high as over 80% and 53% respectively for the youngest children. In line with the study above, the most common error was to misinterpret a distressed or aggressive dog as "happy". Importantly, training lead to significant improvements in children and adults immediately and over time. These studies demonstrate a gradual improvement with age to more accurately perceive dog facial expressions, with higher accuracy rates in adulthood.

Following from the previously discussed research, it would be expected if humans can develop an accurate understanding of human facial expressions (Batty & Taylor, 2006) and dog facial expressions (Meints et al., 2010) as they age, then the same could possibly be said for the human perception of primate facial expressions.

So far the only study to look into the human ability to accurately perceive Barbary macaque facial expressions does not look into the developmental effect, but instead the effect of experience. When asking participants to select how they think images of primates in a questionnaire are feeling; Maréchal, Levy, Meints and Majolo (2017) found that naïve human participants had difficulties in correctly identifying aggressive, distressed and friendly Barbary macaque faces. More specifically they found that naïve participants misinterpreted 60% of aggressive macaque faces compared to a 20% mistake rate in experts. They also found that participants

confused both aggressive and distressed faces both with each other as well as neutral and friendly faces. The study highlights that experience and the type of emotion are what impact levels of accuracy in humans perceiving macaque facial expressions. However, this study only investigates adults perceiving primate facial expressions, so it is unknown if the same applies to children.

A recent study which supports Maréchal et al. (2017) notion that the type of facial expression can influence perception ability, comes from Guo, Li, Yan and Li (2019). They explored human adult perception of human, dog, chimpanzee and Rhesus macaque (*Macaca mulatta*) facial expressions. They found that for neutral expressions, humans performed most accurately for human faces, least accurately for dog faces with chimpanzee and macaque faces equally in between. Whilst for negative expressions, humans performed equally well for both human and dog faces, followed by chimpanzee faces, with macaque negative expressions having the lowest accuracy rating out of all; humans confused them with surprised and happy expressions.

Humans misinterpreting primate facial expressions as they did in Guo et al. (2019) can potentially have dangerous consequences if done in a real-world setting. The research from Maréchal et al. (2017) concluded that negative interspecies interactions are often caused by humans misinterpreting the emotional state of the animal. An animal's emotional state will be inferred by humans from their facial expression; as facial expressions are predictive of the general motivation of the animal to engage in such social interactions (van Hooff, 1972; Waller & Micheletta, 2013). Therefore, when facial expressions are perceived inaccurately, humans might behave inappropriately, such as getting too close to and increasing the risk of an aggressive response (Maréchal et al., 2011; Fuentes, 2006). This can lead to potential injuries for both the tourists and animals, an example of such is a human being bitten by a monkey.

Monkey Bites in Children

Children are said to be at the centre of the wildlife tourism experience (Ballantyne, Packer & Sutherland, 2011). The safety of children in the industry is a cause for concern as monkey bites are an ever-increasing risk to wildlife tourists (Bréhin et al, 2016). Attractive exotic destinations are increasing in popularity for family holidays; however, such destinations are also presenting cases of monkey

bites in children. A north African zoo reported a macaque bite in a 4-year-old boy on the hand, whilst a 10-year-old girl suffered a bite to the thigh by a free-range macaque in Bali (Bréhin et al, 2016). A Thailand based study also concluded that over 50% of animal bites occurred in children, these bites mainly came from dogs, cats, rats and primates (Sriaroon, Sriaroon, Daviratanasilpa, Khawplod & Wilde, 2006). This study also found that the younger children in their sample received more bites to the head and neck area than older children, which will result in more serious injuries meaning younger children are more at risk. Children as a whole are more at risk of receiving an animal bite potentially because of their inexperience, smaller size and lesser ability to fend off any attacks; they can also then be less able to recover from any infection or pathogenic transfer caused by the bite itself (Sriaroon et al., 2006; World Animal Protection, 2017).

Another potential risk factor for animal bites in children is their gender. Ichhpujani et al. (2008) reported that 78.6% of animal bite victims were males, whilst a West African journal article by Osaghae (2011) noted their only case of a primate bite being in an 8-year-old boy. Other studies have also noted the apparent male bias in animal bites received (Sinclair & Zhou, 1995; Majidpour, Sadeghi-Bazarganib & Habibzadehd, 2012). There is currently no explanation as to why this is the case, but it is possible that higher levels of risk-taking in males (Byrnes, Miller & Schafer, 1999) and their greater opportunities to interact with wildlife than females (Webbink, Smits & de Jong, 2012), could be potentially influencing factors.

From the aforementioned research, it is clear that children face an increased risk of animal attacks, and in our focus, attacks from primates. This research will aim to reduce this risk by assessing the factors that cause children to want to come into close proximity with animals. Therefore, as well as measuring how children and adults perceive primates, their behaviour towards the animal needs to also be measured.

Interpreting non-human animal facial expression and Approach Behaviour

Approach and avoidance in human and non-human animals are basic responses associated with aversive and appetitive motivations. Perceiving a potential threat, i.e. a wild animal, would be linked to aversive motivations which would activate avoidant mechanisms – such as withdrawal (Lang, Bradley, & Cuthbert, 1997; Marsh, Ambady, & Kleck, 2005). Fear and anger facial expressions

are thought to be primarily perceived as threatening so should trigger an aversive 'would not approach' response. However, it has been suggested that in animals such as dogs and primates, displays of 'fear' can also potentially be viewed as an act of non-threatening subordination (Marsh et al., 2005). Subordination displays can make animals appear smaller, weaker, juvenile or affiliative (Schenkel, 1967).

There is currently no research on the effect of human ability to interpret animal facial expressions on their likelihood to touch, feed or take a picture with a primate. This is why I believe my research adds valuable insights into a poorly studied research area. Clark, Butler, Ritchie and Maréchal (2020) have however measured how facial characteristics influenced participant behaviour to approach, finding that humans chose to approach macaques who they perceived to be young, cute, female, subordinate, social and trustworthy. Thus, it seems that humans look for positive and non-threatening traits. From Clark et al. (2020) it has been established that humans will chose to approach subordinate animals at a close proximity. Therefore, fear expressions, along with friendly and neutral, in primates may in fact elicit an approach response whilst in this study, I predict that aggressive expressions (primate and human) should still evoke an avoidance response.

Potential Contributing Factors to the recognition of facial expression

Research has consistently found a link between pet ownership, pet attachment, positive attitudes to animals, compassion, empathy, and prosocial behaviour. In particular, attachment to pets significantly predicts positive attitudes towards animals (Hawkins & Williams, 2017). The quality of the attachment a child has with their pet can impact their cognitive abilities, social competence and play behaviour (Purewal et al., 2017). Such factors may influence a child's ability to perceive facial expressions or effect their behaviour towards animals. Pets can also facilitate the development of empathy in children (Rothgerger & Mican, 2014) and empathy towards animals has previously been found to influence child ability to perceive dog facial expressions (Kujala, Somppi, Jokela, Vainio & Parkkonen, 2017).

Caring for pets during childhood has been shown to relate to more humane attitudes towards animals and a greater concern for animal welfare later in life (Wells & Hepper, 1997; Paul & Serpell, 1993). Therefore, if we can encourage children to participate in pet care and raise awareness and positivity towards pets in children, this could lead to not only a more humane treatment in pets, but also wild animals in

a tourism setting. This theory needs to be tested, and whilst a high attachment towards pets can facilitate a nurture response in children and more humane behaviour, a low attachment has been related to higher acceptance of animal cruelty (Hawkins & Williams, 2016). Animal cruelty and neglect can be associated with a lack of emotional attachment between child and their pet. Therefore, I propose to test the effect of pet attachment and animal cruelty levels in children on their behaviour towards and perception of Barbary macaques.

To be able to measure animal experience and exposure in children, the Short Attachment to Pet's Scale (SAPS; Marsa-Sambola et al., 2015) was administered to the children in this study. The scale measures the quality of the relationship and attachment that the child has with their pets. The Children's Attitudes and Behaviours Towards Animals (CABTA; Guymer, Mellor, Luk & Pearse, 2001) questionnaire was also included as it measures general behaviour towards animals as well as cruelty behaviour in detail.

Wildlife tourism is often a family experience, meaning that during unsafe human-macaque interactions, the whole family is either witnessing or encouraging the behaviour. A child's perception and understanding of safety most often relies on the knowledge and guidance of nearby adults, more than likely parents (Reisner & Shofer, 2008). Therefore, the behaviour of a child during an animal interaction, is often supervised by that of a parent. This suggests that any existing knowledge of facial or behaviour signalling and safety awareness around macaques may correlate amongst parent and child. Meints et al. (2018) tested intergenerational effects to find no significant correlations between children's and their parents' judgments of the dogs' signalling behaviours before or after training. This research would suggest there to be no intergenerational effect on ability to perceive macaque facial expressions. However, this does not cover the effects on approach behaviour, the main safety risk. Traits such as risk taking and social anxiety have been found to correlate in parents and their children (Murrary et al., 2008; Serbin & Karp, 2003). Such social factors could greatly influence approach behaviour in humans, with high risk taking and low anxiety favouring a close interaction. If most adult humans are unaware of the safety practices surrounding human – macaque interactions, for instance the recommendation to keep a 10m distance, then their children will not be aware either. It is important to test any intergenerational effects between parents

and children as if a significant effect exists, it would be evidence to suggest the improvement of education in particularly parents due to their influential effects.

Hypotheses

In the current study, I expand on past research which explores human perception of Barbary macaques (Maréchal et al., 2017; Clark et al., 2020) to investigate the developmental differences of facial expression perception between species by exploring (1) whether human accuracy of facial expression perception is determined by the species perceived, type of expression, age, gender, intergenerational effects or behaviour towards animals; (2) whether age, gender and human perception of Barbary macaque facial expressions will influence participant intended proximity to approach, feed or take a selfie with the macaques; (3) If human self-reported behaviour will accurately represent simulated real-life perception of and behaviour towards Barbary macaques. I hypothesise that human ability to accurately perceive Barbary macaque facial expressions will not be impacted by the same factors that influence human ability to perceive human facial expressions. More specifically, age and gender will positively relate to ability to perceive human facial expressions, whilst they will not relate to ability to perceive macaque facial expressions. For ability to accurately perceive Barbary macaque facial expressions, I predict that factors such as intergenerational effects and reported behaviour towards animals such as attachment to pets and cruelty behaviour may influence this alongside the type of facial expressions. I predict age and gender will negatively relate to distance willing to approach the Barbary macaques, with younger males approaching at closer distances. Following this I expect to develop and provide information to improve upon and make wildlife tourism safer for all ages, with a greater understanding of interspecies communication and child development.

Children aged 4-10 years old, students aged 18-22 years old and adults aged 25 years and older took part in two tasks randomly presented to measure their facial expression recognition ability and behaviour towards humans and Barbary macaques. The first task was an online questionnaire consisting of 36 images of happy, angry, scared and okay human and Barbary macaque faces. Then, a practical task consisting of 5 life-size cardboard monkeys with the 5 same facial expression presented to participants.

2. Methods

The following methodology was carried out on three age groups, children, their parents and students from the University of Lincoln. The child method section will be presented separately to the adult method (parents and students) because of slight differences in the procedure due to practicality and ethical concerns. The questionnaire needed to be simpler and shorter for ease of completion by the children, and it was decided minimal questioning surrounding approaching the macaques was needed as to not encourage the behaviour.

2.2.1. Participants

This study aimed to recruit 75 children (25 from each age group) and one of their parents, as well as 50 students.

A total of eighty-one children were recruited for the study, consisting of thirty 4-6-year old's (13 males, 17 females), twenty-nine 7-8-year old's (13 males, 16 females) and twenty-two 9-10-year old's (9 males, 13 females) to represent three key developmental stages. A total of fifty-eight parents or guardians were recruited consisting of 8 males and 50 females, aged between 26 and 66 years old (M = 37.47, SD = 7.04). Participants and their parents were recruited through the University of Lincoln's summer scientist programme, the University of Lincoln's Infant and Child Development Lab's participant records and posters around the University (Appendix E1).

A total of forty-five students from the University of Lincoln were recruited consisting of 18 males and 27 females, aged between 18 and 22 years old (M = 19.4, SD = 0.92). Participants were recruited by University of Lincoln undergraduate psychology students. All participants had normal or corrected to normal vision.

The researchers for this study were all DBS checked and the study methodology was made suitable for children, the application was submitted via the Lincoln Ethics Application System and ethically approved by the University of Lincoln Human/ Non-Human Research Ethics Committee (approval code: LEAS 2019-0854 and PSY192039) (Appendix A1).

2.2.2. Materials

Questionnaire stimuli

The questionnaire was made using Qualtrics software, version 07/19. The

stimuli used for the questionnaire included 36 images of faces, 16 human faces (male and female) with the expressions of happy, angry, fearful, neutral and 20 Barbary macaque faces with the expressions of friendly, aggressive, very aggressive, distressed and neutral. For both the human and macaque images the general child friendly terms of happy, okay, scared and angry were used based on the methodology of Meints et al. (2018). All 36 images were randomly presented to every participant (Appendix F1). The human images were obtained from the Karolinska Directed Emotional Faces (KDEF; Lundqvist, Flykt & Öhman, 1998), the Barbary macaque images were supplied by Dr. Laëtitia Maréchal, Prof. Julia Fisher and Andrew Forsyth (Figure 2).

Figure 2.

Example Stimuli

Note: An example of a 'happy' expression in both the human and Barbary macaque stimuli.

Included in the child questionnaire, was the Short Attachment to Pets Scale (SAPS) for Children and Young People developed by Marsa-Sambola et al. (2015). The questionnaire consists of 9 items, answered by the child participants using a 5-point Likert scale from 1 (strongly agree) to 5 (strongly disagree). The final score for the participants is a sum of the items, where Items 2–9 are reverse recoded. Higher scores indicated higher levels of attachment towards a pet. The Cronbach's alpha for the scale is 0.894, the scale has promising reliability and validity but there is no measure of test-retest reliability (Appendix F1).

In addition to the adult questionnaire, parents or carers were asked to complete the Children's attitudes and behaviours towards animals (CABTA; Guymer, Mellor, Luk & Pearse, 2001) questionnaire about their child, to measure cruelty towards animals. The questionnaire consists of 24 questions split into three sections summarising demographics, the child's behaviour towards animals and animal cruelty behaviour; using either a 5-point scale ranging from never (0) to always (4) or yes (1) or no (0) options. Three scores are derived from the questionnaire, a score of malicious cruelty (a = 0.54), typical cruelty (a = 0.76) and a total score (a = 0.79); higher scores correlated to higher cruelty levels. The scale is reliable, valid with good test-retest reliability and is therefore a true measure for detecting childhood cruelty to animals (Appendix F1).

Practical task stimuli

For the practical task five macaque stimuli were made. Five Barbary macaque faces, not used in the questionnaire, with each of the five facial expressions (friendly, neutral, distressed, aggressive, very aggressive) were edited onto the same macaque body using Adobe Photoshop (Appendix F1). The new images were then printed to be 65cm, representative of the average Barbary macaque height. The images were then cut out and adhered onto cardboard, so they could stand. For the practical task the cardboard monkeys were positioned against a white wall 30cm away from each other, taking up a total distance of approximately 3m. Lines were marked out on the floor using masking tape, measuring from the centre of each monkey 5m outwards. The distance between each of the five tape lines measured 73cm. Distance marks were made on the tape, at 50cm increments, to measure how close participants approached the monkeys (Figure 3).

Figure 3.

Study set up

Note: Demonstrates the set-up of the practical task with the five cardboard monkeys with different facial expressions.

2.2.3. Design

Each participant took part in both the questionnaire and practical task. The order both tasks were presented to participants was alternated to counterbalance and control for any carryover effects; different images were used for both tasks.

2.2.4. Procedure

Participants were welcomed to the study and provided with an information sheet (Appendix B1), the tasks were explained to them and the researcher checked with each participant that they had no animal specific phobias or heightened sensitivity to emotional expression. Verbal consent was gained from the child and written consent from the parent or guardian on behalf of themselves and their child (Appendix C1), it was also emphasised by the researcher that the participants were free to stop or take a break at any point. The researcher used images of SpongeBob SquarePants to practice the four facial expressions with the child that they will be asked to use throughout the study: happy, okay, scared and angry, to ensure the child understood the task (Appendix F1). The researcher then began either the practical task or questionnaire with the child whilst the research assistant began

either the practical task or questionnaire with the parent. The order that the two tasks were presented was alternated for each new participant. Wall dividers were used to separate the practical task and questionnaire task.

Practical task

Prior to the study starting the cardboard monkey stimuli were set up in a random order predetermined by a list of randomly generated numbers, with the monkeys facing the wall so they cannot be seen until the practical task begins. The participant was positioned at the end of the 5m mark in the middle by the researcher. They were told to imagine that they were in a jungle and to pretend that these are real monkeys they were about to see. The participant was then asked to turn around and close their eyes whilst the researcher turns around the monkeys. When the researcher returned, the participant was to turn around and then instructed to walk across the line to look at each monkey but not to go past the 5m line. Once back in the middle of the line the researcher ensured that the participant could see the monkeys and then asked them which monkey their favourite was and why. Throughout the practical task the researcher wrote down everything the participant said and did in response to the questions asked. At the start line the researcher asked the participant how they think each of the five monkeys were feeling, from left to right, using the options happy, okay, scared and angry; randomising the options as they go. The participant was allowed to take a closer look at any of the monkeys if they needed to for this question. Participants were then asked the following as outlined in child and adult procedure below.

Child procedure:

The participant was asked if they would like to get closer to any of the monkeys. If they said no, then the researcher moved onto the next question. If they said yes, they were then asked which monkey they would like to get closer to and to show the researcher how close they would like to get. At end of the practical the participant was thanked for their time and either invited to take part in the questionnaire task (if applicable) or debriefed (Appendix D1).

Adult Procedure:

The participant was asked how close they would like to get to each of the

monkeys (starting from left to right) and to show the researcher how close they would like to get. The participant could stay at the 5m line if they wanted to. At the end of the practical, the adult was thanked for their time and either invited to take part in the questionnaire task (if applicable) or debriefed.

Questionnaire

Child procedure:

The researcher sat with the participant throughout the questionnaire task and read out the questions, potential answers and filled in their response. The questionnaire asked for the participants' age, gender and how much they like/dislike animals and how much they like/ dislike monkeys on a 5-point Likert scale of strongly agree to strongly disagree. If the participant had any pets, they were then to complete the SAPs questionnaire. At the end of the SAPs the researcher explained that images of either monkeys or humans will appear on the screen for 10 seconds and that in that time the child will be asked to look at the picture and tell the researcher how they think the monkey/ human is feeling using the options of scared, happy, okay or angry. The researcher repeated these instructions, randomising the order of the options, for each of the images. At the end of the questionnaire the child was thanked for their participation and asked if they would like to do the practical task (if applicable) or debriefed.

Adult procedure:

Adults were supervised and guided by the research assistant. They were offered headphones to help avoid any distraction and then they were to complete the questionnaire unassisted with any questions being answered by the research assistant. Adults were asked the same questions as described in the child questionnaire (excluding the SAPs) with the addition that for each image adults were also asked 'how close are you willing to approach this monkey/ human? How close are you willing to approach this monkey/ human to take feed them? How close are you willing to approach this monkey/ human to take a selfie with them?'. For these three questions participants could select either 'would not approach', 'touching (0m)', or a distance between 1 and 5 metres in 1m increments. At the end of the questionnaire, participants were thanked and asked to complete the CABTA about

their child (if applicable), followed by the practical task (if applicable), or debriefed.

2.2.5. Data Analysis

With normally distributed, parametric data, a series of two-way ANOVAs and an independent t test were used SPSS v26. To test for any significant differences or interactions between age and gender for distance willing to approach and number of correct expressions perceived. For both the practical and questionnaire, a series of confusion matrices were made to show how participants perceived the macaques.

Two generalized linear mixed models (GLMM) were used to investigate whether participants ability to accurately assess each human or macaque facial expression was predicted by their age group (4-6, 7-8, 9-10, 18-22 and 25-70 years old) or the type of facial expression (human: happy, neutral, scared, angry, macaque: friendly, neutral, distressed, aggressive, very aggressive). Participants' ability to recognise facial expressions was binary (1 = yes, 0 = no) whilst age and expression were categorical. The participants and images identification numbers were included as random factors. The GLMM was run using R studio cloud, using the glmer function from the lme4 package (family = "binomial"). The significance of the full model was compared to the corresponding null model, containing only the dependent variable and the two random factors.

A third generalized linear mixed models (GLMM) was used to investigate whether children's ability to accurately assess each macaque facial expression was predicted by their age group (4-6, 7-8, 9-10), the type of facial expression (friendly, neutral, distressed, aggressive, very aggressive), their attachment to pets (high or low), cruelty scores (high or low for malicious and typical cruelty), dog ownership (yes or no) and gender (male and female). Models were checked to assess whether they violated any assumptions, including collinearity (VIF function, all VIF results <4), outliers (Cook's distance <1, no outlier found), distribution and homogeneity of the residuals (Field, Miles & Field, 2012).

SPSS v26 was also used to carry out a spearman's rank-order correlation to determine the relationship between children and their parent's responses in the questionnaire and practical task. If a child chose not to approach a macaque in the practical, this was coded here as a '5' for 5m (the maximum practical distance) to coincide with the parent data. For this analysis only the child's mother or father were

classed as a ‘parent’. Children who completed the study with a guardian such as a grandparent or nanny for example, were not included in this analysis. The data was not normally distributed, so a non-parametric test was used.

As the data was not normally distributed, a Wilcoxon signed ranks tests was used to compare how perception of the macaques influences participant willingness to approach them. This was done using the mean distance participants chose to approach the macaques by their actual facial expressions and how participants perceived their expression to be. In instances where participants did not perceive any macaques to be a certain expression, this data was omitted from the analysis. For this analysis, the distance ranged from 0 – 6, with the option of ‘would not approach’ classed as 6.

Further Wilcoxon signed ranks tests were used to compare how participants behaviour towards and perception of the macaque differs between the questionnaire and practical. Firstly, distance between the tasks were assessed, with distance ranging from 0-5, with ‘would not approach’ classed as 5 to match the practical limit. For correct assessment of the expressions, each questionnaire correct answer equalled 0.25 with a maximum score of 1 for each 5 images per expression to match the practical.

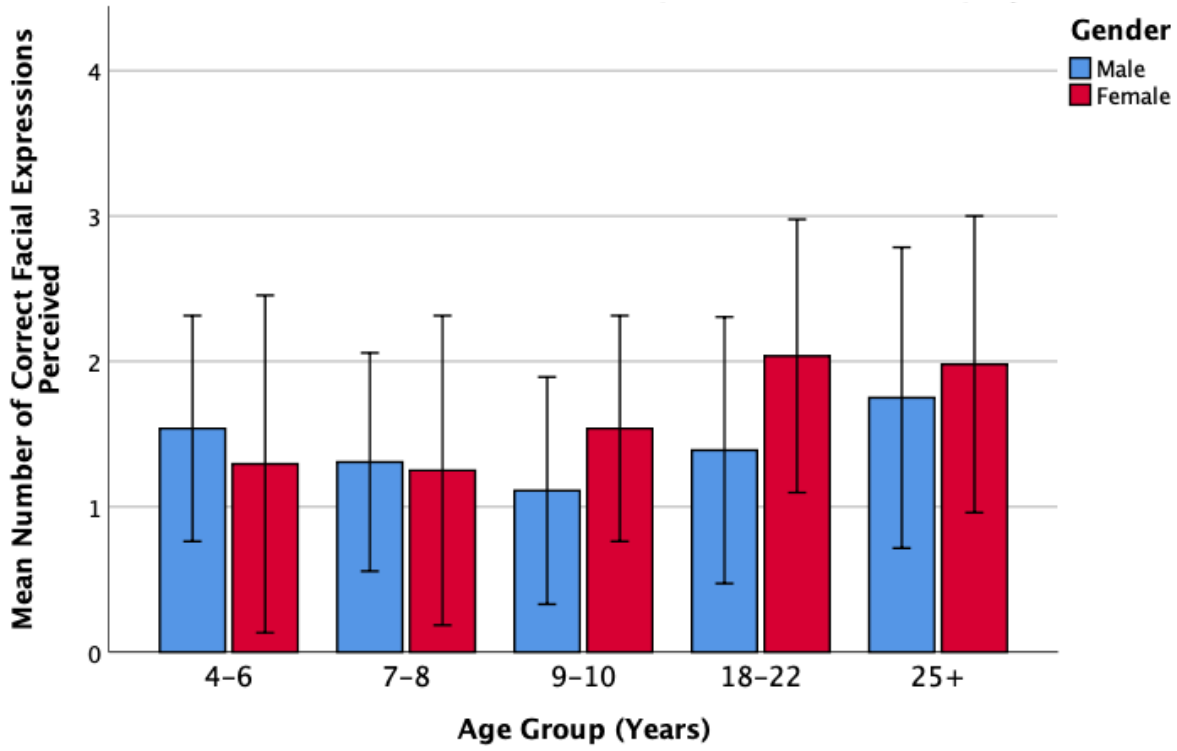
2.3. Results

2.3.1. Facial expression categorisation ability for all ages in the Practical Task

A two-way ANOVA was conducted that examined the effect of age and gender on the number of correct macaque facial expression perceived by all participants in the practical task (Figure 4). No main effect of age (F (4, 174) = 2.060, p = 0.088, partial η2 = 0.45) or gender (F (1, 174) = 1.559, p = 0.213, partial η2 = 0.009) was statistically significant. There was no statistically significant interaction between the effects of age and gender on the number of correct macaque facial expression perceived (F (4, 174) = 1.179, p = 0.322, partial η2 = 0.026).

Figure 4.

Mean number of correct facial expressions perceived by age and gender



Note. Mean number of correctly perceived macaque facial expressions in the practical task (out of 5) split by gender and age group (error bars 1 SD).

As shown in Table 1 below, children, students and adults mostly confused the distressed macaque as feeling 'happy' (82.4%, 88.9% and 60.3%) and the aggressive macaque as feeling 'okay' (54.1%, 71.1% and 53.4%). Children and Students confused the neutral macaque as feeling 'angry' (66.2% and 51.1%). Children also confused the very aggressive macaque as feeling 'happy' or 'scared' (32.4%).

Table 1.

Confusion matrix to show what percentage of participants perceived each macaque model's facial expression to be in the practical task, split by age group.

Age Group	Actual	Predicted (%)			
		Happy	Okay	Scared	Angry
Child	Friendly	**77**	20.3	1.4	1.4

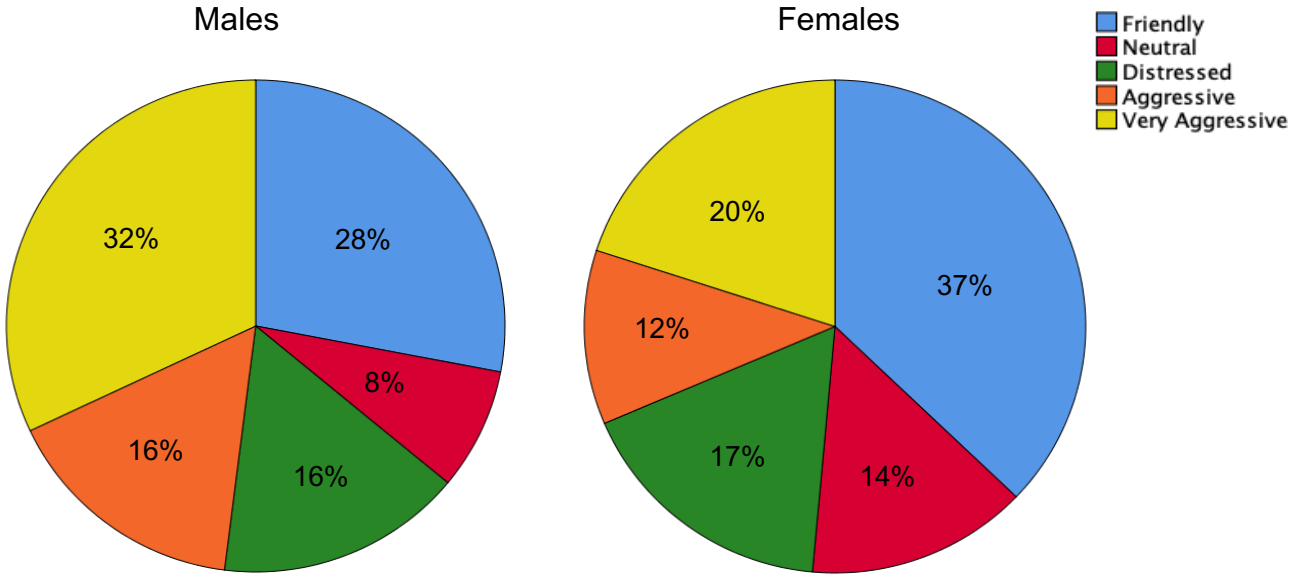
	Neutral	5.4	20.3	8.1	**66.2**
	Distressed	**82.4**	13.5	4.1	0
	Aggressive	10.8	**54.1**	27	8.1
	Very Aggressive	**32.4**	10.8	**32.4**	24.3
Student	Friendly	**64.4**	11.1	20	4.4
	Neutral	0	44.4	4.4	**51.1**
	Distressed	**88.9**	2.2	8.9	0
	Aggressive	8.9	**71.1**	20	0
	Very Aggressive	15.6	4.4	20	**60**
Adult	Friendly	**62.1**	15.5	20.7	1.7
	Neutral	1.7	**50.0**	10.3	37.9
	Distressed	**60.3**	10.3	24.1	5.2
	Aggressive	18.9	**53.4**	22.4	5.2
	Very Aggressive	24.1	3.4	19.0	**53.4**

2.3.2. Distance Willingness to Approach macaques in the Practical Task for each age group

Of the 60 Child participants who chose to approach the macaque models, Figure 3 shows that nearly half of the males (48%) chose to approach the more aggressive or very aggressive macaque models compared to 32% of females, whilst over half of the females (51%) compared to 36% of boys chose to approach the friendly or neutral macaque models (Figure 5).

Figure 5.

Percentage of chosen macaque facial expression to approach by gender in children

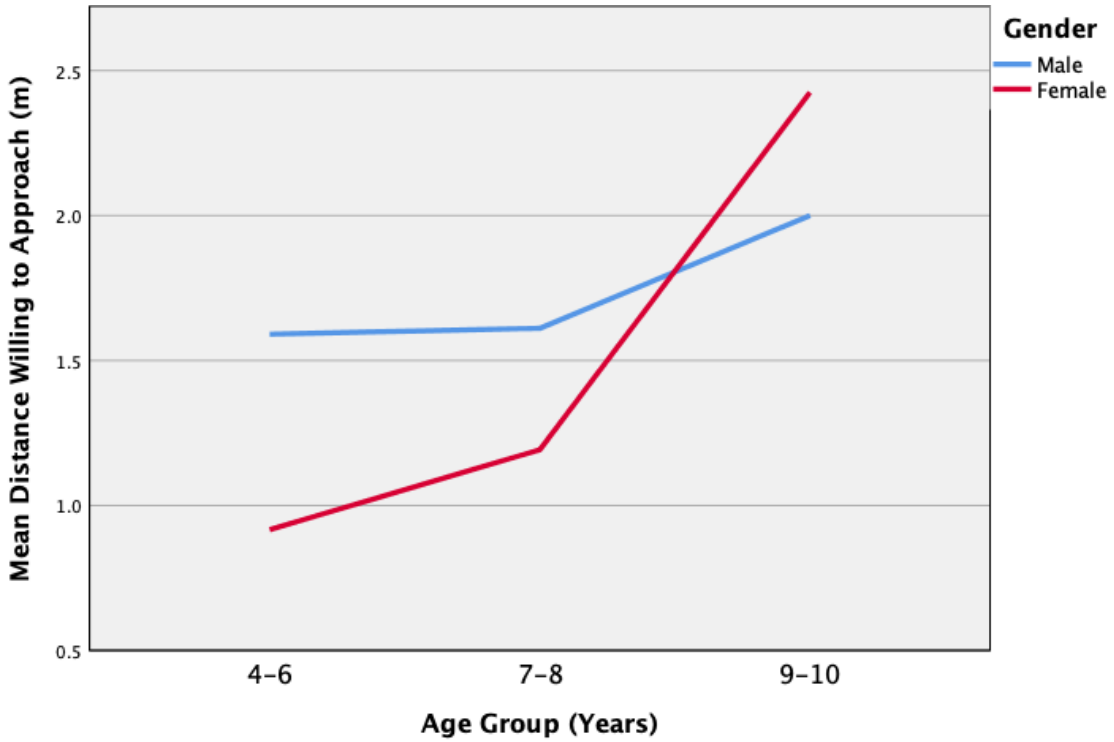


Note: Pie Charts demonstrating the percentage of which macaque model female and male children chose to approach in the practical task.

A two-way ANOVA was conducted that examined the effect of age and gender on distance willing to approach the macaque models in children (Figure 6). There was a significant main effect for the participants' age (F (2,54) = 3.277, p = 0.045, partial η2 = 0.108). There was no main effect of gender (F (1, 54) = 0.531, p = 0.469, partial η2 = 0.010). There was no significant interaction either between the effects of age and gender on distance willing to approach (F (2, 54) = 1.034, p = 0.363, partial η2 = 0.037). A Tukey post hoc test revealed that younger children (4-6-year old's: 1.24 ± 1.22m, p = 0.019; 7-8-year old's: 1.37 ± 1.04m, p = 0.047) approached the macaque models closer than older children (9-10 year old's: 2.28 ± 1.11m).

Figure 6.

Mean distance willing to approach by age and gender



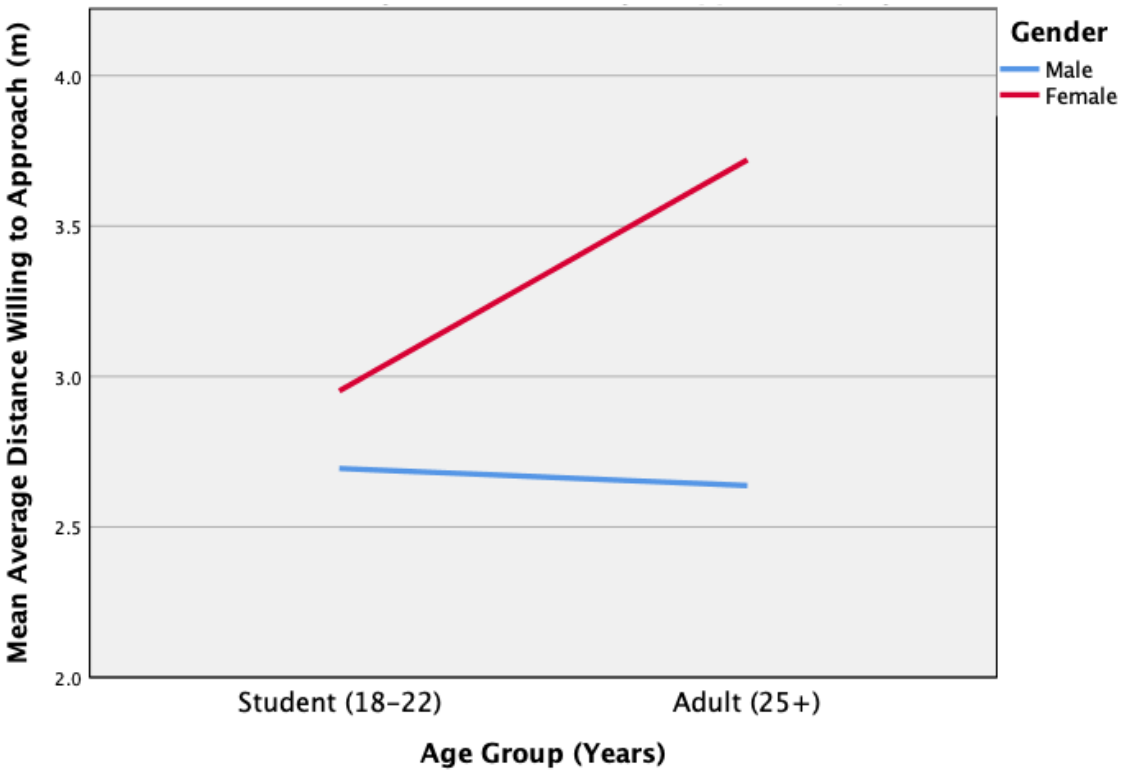
Note: Graph comparing distance willing to approach a macaque model for each age group split by gender. Showing children approached the macaque models from further away on average the older

they were.

A two-way ANOVA was conducted that examined the effect of age and gender on distance willing to approach the macaque models in students and adults (Figure 7). There was a significant main effect for the participants' gender (F (1,99) = 6.837, p = 0.010, partial η2 = 0.065), such that males (2.68 ± 0.81m) approached the macaque models closer than females (3.45 ± 1.17m). The main effect of age was not statistically significant (F (1, 99) = 1.926, p = 0.168, partial η2 = 0.019), neither was there a significant interaction between age and gender on distance willing to approach *(F* (1, 99) = 2.593, p = 0.111, partial η2 = 0.026).

Figure 7.

Mean average distance willing to approach by age and gender



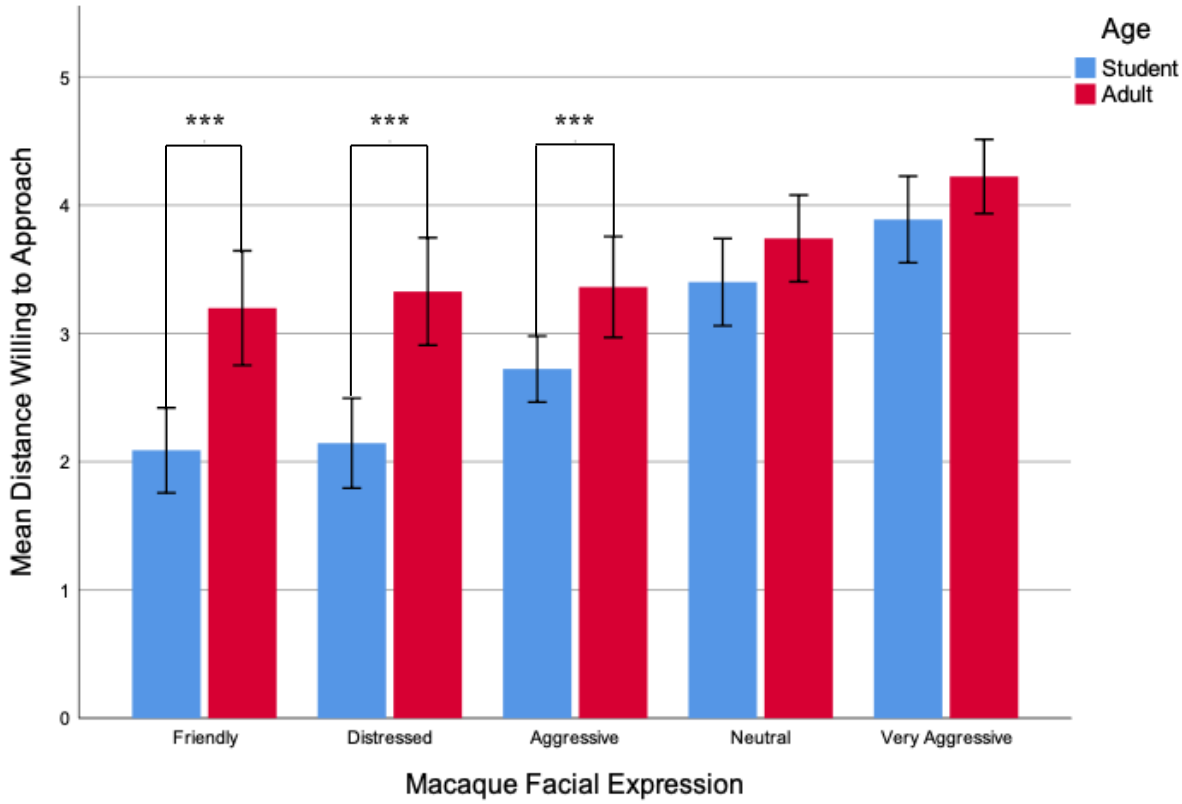
Note: Graph comparing distance willing to approach a macaque model for each age group split by gender. Showing females approached the macaque models from further away on average than males.

To investigate the differences between students' and adults' distance willing to approach, for each facial expression, an independent samples t test was conducted. An independent samples t test found a statistically significant difference

between distance willing to approach the friendly macaque for students and adults (t (100) = -7.010, p < .001); distance willing to approach the distressed macaque for students and adults (t (101) = -4.639, p < .001); and distance willing to approach the aggressive macaque for students and adults (t (101) = -7.587, p < .001). Students on average got statistically significantly closer to the friendly, distressed and aggressive macaques then adults did. There was no significant difference between distance willing to approach neutral or very aggressive macaques for students and adults, as well as no average difference between the two age groups (Figure 8).

Figure 8.

Mean distance willing to approach macaques by facial expression and age



Note: Mean distance willing to approach each macaque facial expression in students and adults. Shows varying mean approach distances depending on expression and three significant differences between students and adults, where students approach significantly closer than adults (error bars 1 SD). * P<0.05, ** P<0.01, *** P<0.001.

2.3.3. Facial expression categorization ability in the Questionnaire

The below confusion matrix shows the difference in perception of macaque facial expressions between the five age groups (Table 2). It shows that the three

child age groups most often accurately perceived the friendly macaques to be ‘happy’ whilst students and adults inaccurately perceived the friendly macaque to be ‘okay’. On the other hand, the three child age groups inaccurately perceived neutral macaques as ‘angry’, whilst adults and students accurately perceived them to be ‘okay’. All five age groups showed poor performance in accurately perceiving distressed and aggressive facial expressions, perceiving them as ‘happy’ and okay’ respectively. In the two youngest age groups, very aggressive macaques were mostly perceived inaccurately to be ‘scared’, compared to the 9-10-year old’s who mostly perceived them to either be ‘happy’ or accurately as ‘angry’. Both students and adults accurately perceived the very aggressive macaque to be ‘angry’

Table 2.

Confusion matrix to show what participants perceived each group of macaque facial expressions to be in the questionnaire, split by age group.

Age Group	Actual	Predicted (%)			
		Happy	Okay	Scared	Angry
4 - 6	Friendly	**53.6**	19.6	17	9.8
	Neutral	7.1	17	9.8	**66.1**
	Distressed	**61.6**	2.7	4.5	31.3
	Aggressive	31.3	**33**	32.1	3.6
	Very Aggressive	17.9	8	**40.2**	33.9
7 - 8	Friendly	**47.4**	28.4	13.8	10.3
	Neutral	0	29.3	12.1	**58.6**
	Distressed	**63.8**	9.5	9.5	23.3
	Aggressive	5.2	**37.1**	55.2	2.6
	Very Aggressive	12.1	7.8	**41.4**	38.8
9 - 10	Friendly	**53.4**	23.9	17	5.7
	Neutral	0	27.3	10.2	**62.5**
	Distressed	**62.5**	4.5	5.7	27.3
	Aggressive	25	**33**	30.7	11.4
	Very Aggressive	**33**	9.1	25	**33**
18-22	Friendly	26	**32.3**	19.3	22.4
	Neutral	0.5	**45.3**	9.4	44.8
	Distressed	**49.5**	6.3	8.9	35.4
	Aggressive	12.5	**58.3**	22.4	6.8
	Very Aggressive	20.3	6.3	21.4	**52.1**
25+	Friendly	30.4	**33.4**	19.6	16.5
	Neutral	0	**51.3**	12.5	36.2

Distressed	**50.9**	12.9	10.7	25.4
Aggressive	8.9	**57.1**	30.4	3.6
Very Aggressive	16.5	9.4	28.1	**46**

2.3.4. Will age and gender significantly impact human ability to accurately perceive human and Barbary macaque facial expressions.

A two-way ANOVA was conducted that examined the effect of age and gender on the mean number of correct facial expression perceived by all participants in the questionnaire (Figure 9). For human facial expressions, there was a significant main effect of the participants' age group (F (4, 172) = 20.286, $p < 0.001$, partial η2 = 0.321). A Tukey post hoc test revealed that correct human facial expressions recalled were significantly less for children aged 4-6 years old (76.79 ± 14.12) compared to 7-8 year old's (86.21 ± 11.25, $p = 0.001$), 9-10 year old's (90.34 ± 8.78, $p < 0.001$), 18-22 year old's (94.86 ± 4.86, $p < 0.001$) and 25+ year old's (94.18 ± 6.29, $p < 0.001$). Mean correct human facial expressions recalled was also statistically significantly less for children aged 7-8 years old compared to adults aged 18-22 years old ($p = 0.001$) and 25-70 years old ($p = 0.001$). The main effect of gender was not statistically significant (F (1, 172) = 3.057, $p = 0.082$, partial η2 = 0.017). There was no significant interaction between age and gender on the number of correct human facial expression perceived in the questionnaire *(*F (1, 172) = 0.673, $p = 0.612$, partial η2 = 0.015).

For Barbary macaque facial expressions, no main effects of age (F (4, 172) = 2.179, $p = 0.073$, partial η2 = 0.048) or gender (F (1, 172) = 0.22, $p = 0.883$, partial η2 < 0.001) were statistically significant. There was no significant interaction between age and gender on the number of correct facial expression perceived, *(*F (4, 172) = 0.710, $p = 0.586$, partial η2 = 0.016).

Figure 9.

Mean correct recall of human and macaque facial expressions by age

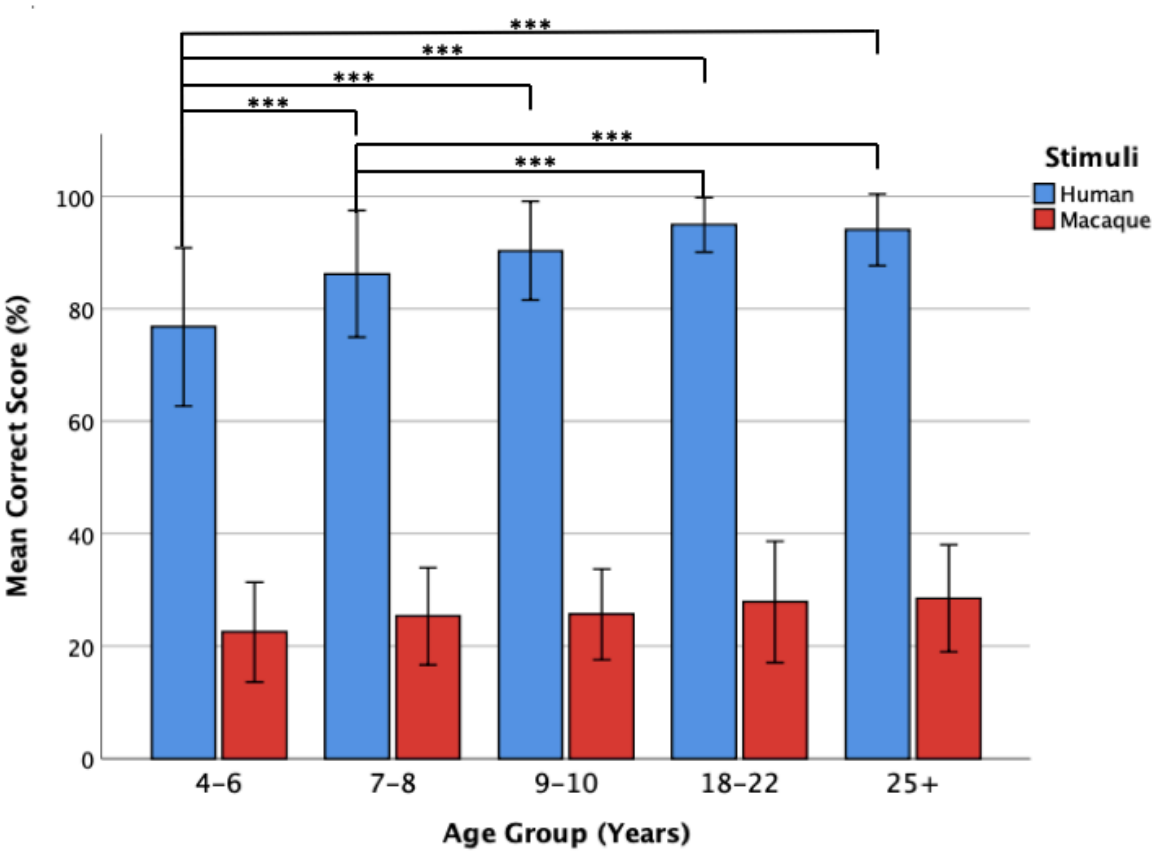


Figure 9. Percentage mean score for amount of human and macaque facial expressions accurately perceived by participants split by age group (error bars 1 SD). * P<0.05, ** P<0.01, *** P<0.001.

Age significantly predicted participants ability to recognise human, but not Macaque, facial expressions, with performance decreasing from adult to child (Table 3), performance decreased from 25-70- and 18-22-year old adults > 9-10- and 7-8-year old's > 4-6-year old children. There was a significant difference in the participants' performance depending on the type of facial expression, happy expressions were easier to accurately assess than neutral (p = 0.001) and angry expressions (p = 0.032). There was no significant difference between scared expressions and happy, neutral or angry expressions (Figure 10).

Table 3.

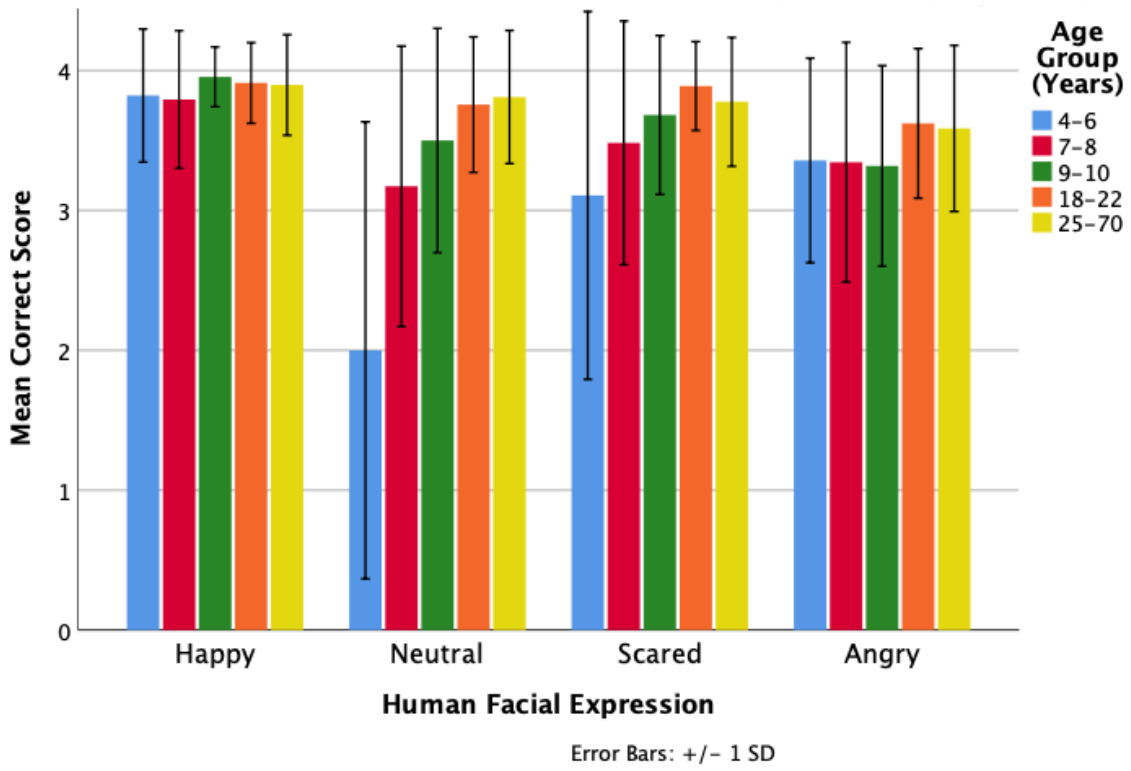
Human GLMM

Full vs. null	*N*	χ2	df	*p*
	2912	0	7	1
	Estimate	±SE	*z*	*p*
Intercept	2.795	0.455	6.147	**<0.001**
Age				
4-6 vs. 7-8	0.808	0.243	3.322	**0.001**
4-6 vs. 9-10	1.232	0.281	4.379	**<0.001**
4-6 vs. 18-22	1.960	0.255	7.675	**<0.001**
4-6 vs. 25-70	1.836	0.235	7.799	**<0.001**
7-8 vs. 9-10	0.423	0.288	1.469	0.142
7-8 vs. 18-22	1.152	0.262	4.394	**<0.001**
7-8 vs. 25-70	1.028	0.242	3.243	**<0.001**
9-10 vs. 18-22	0.729	0.296	2.465	**0.014**
9-10 vs. 25-70	0.604	0.278	2.173	**0.030**
18-22 vs. 25-70	-0.124	0.251	-0.494	0.621
Expression				
Happy vs. Neutral	-1.942	0.589	-3.296	**0.001**
Happy vs. Scared	-1.159	0.596	-1.946	0.052
Happy vs. Angry	-1.286	0.601	-2.140	**0.032**
Neutral vs. Scared	0.782	0.565	1.383	0.167
Neutral vs. Angry	0.654	0.571	1.145	0.252
Scared vs. Angry	-0.128	0.578	-0.221	0.825

Note: Results of the GLMM testing the difference in participants' abilities to correctly assess the humans emotional state based on their age and type of facial expression. Bold values show statistically significant P values ($p < 0.05$).

Figure 10.

Mean correct recall of human facial expressions by age group



Note: The difference between mean correct score between each facial expression category for humans by age group.

Age did not overall significantly predict participants ability to recognise macaque facial expressions (Table 4). There was a significant difference in ability between 4-6-year-old children and both of the 18-22 (p = 0.021) and 25-70 (p = 0.006) adult age groups. In addition, there was a significant difference in participant performance depending on the type of facial expression with aggressive and distressed expressions being more difficult to accurately perceive than neutral, friendly, and very aggressive expressions (Figure 11). Performance between aggressive and distressed were not significantly different, nor were the performance between neutral, friendly and very aggressive.

Table 4.

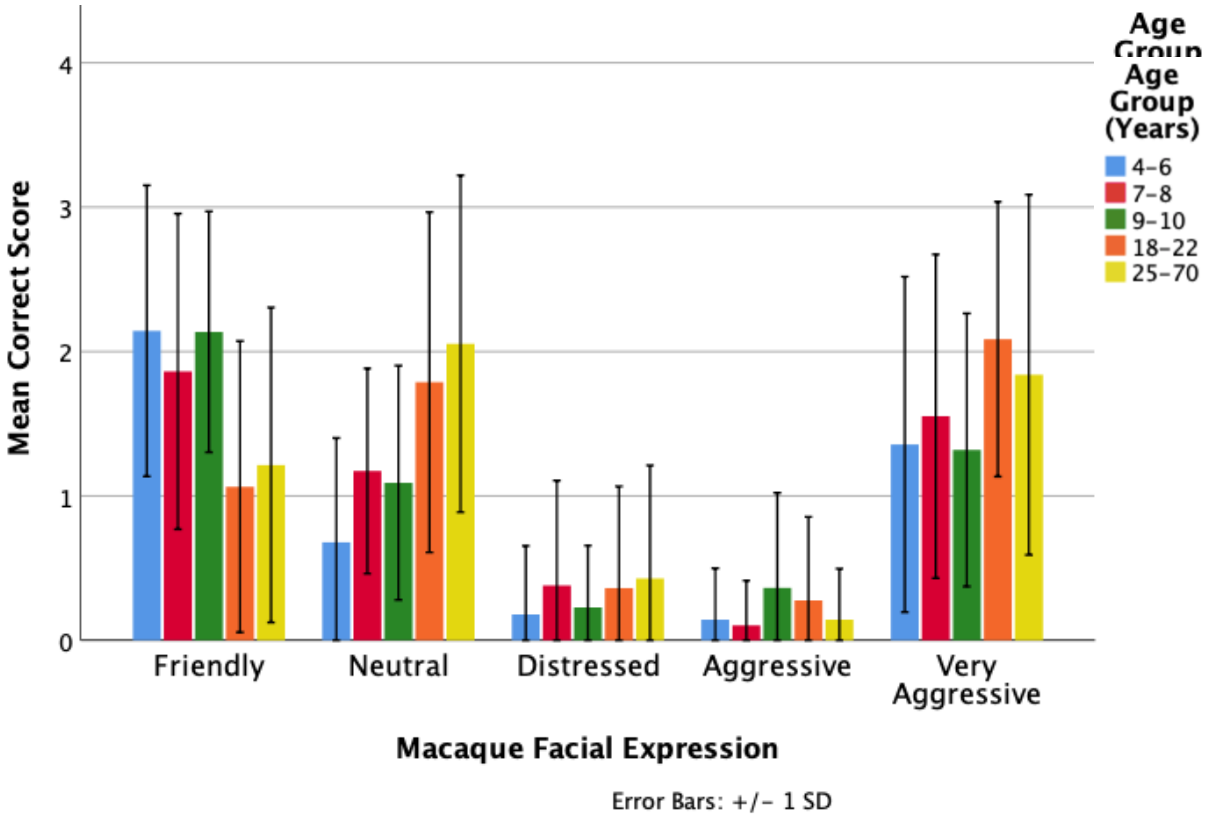
Macaque GLMM

Full vs. null	*N*	χ2	df	*p*
	3640	1140.8	8	**<0.001**
	Estimate	±SE	*z*	*p*
Intercept	-0.256	0.516	-0.496	0.620
Age				
4-6 vs. 7-8	0.219	0.180	1.218	0.223
4-6 vs. 9-10	0.236	0.194	1.218	0.223
4-6 vs. 18-22	0.377	0.164	2.302	**0.021**
4-6 vs. 25-70	0.434	0.157	2.769	**0.006**
7-8 vs. 9-10	0.017	0.190	0.088	0.930
7-8 vs. 18-22	0.158	0.159	0.989	0.322
7-8 vs. 25-70	0.215	0.152	1.411	0.158
9-10 vs. 18-22	0.141	0.174	0.809	0.419
9-10 vs. 25-70	0.198	0.167	1.182	0.237
18-22 vs. 25-70	0.057	0.131	0.435	0.663
Expression				
Friendly vs. Neutral	-0.105	0.668	-0.157	0.875
Friendly vs. Distressed	-2.019	0.668	-2.979	**0.003**
Friendly vs. Aggressive	-2.937	0.703	-4.177	**<0.001**
Friendly vs. Very Aggressive	0.135	0.668	0.202	0.840
Neutral vs. Distressed	-1.915	0.679	-2.819	**0.005**
Neutral vs. Aggressive	-2.832	0.704	-4.019	**<0.001**
Neutral vs. Very Aggressive	0.358	0.721	0.358	0.721
Distressed vs. Aggressive	-0.917	0.712	-1.287	0.198
Distressed vs. Very Aggressive	2.155	0.679	3.176	**0.002**
Aggressive vs. Very Aggressive	3.072	0.705	4.358	**<0.001**

Note: Results of the GLMM testing the difference in participants abilities to correctly assess the macaques emotional state based on their age and type of facial expression. Bold values show statistically significant P values ($p < 0.05$).

Figure 11.

Mean correct recall of macaque facial expressions by age group



Note: The difference between mean correct score between each facial expression category for macaques by age group.

The individual differences shown in Table 5 did not significantly predict the children's ability to accurately recognise macaque facial expressions; the children's attachment to pets, cruelty levels, whether they owned a dog, gender or age had no influence on their ability to perceive macaque facial expressions. There was a significant difference in the participants performance depending on the type of facial expression, with aggressive, neutral and distressed expressions being more difficult to accurately perceive than friendly and very aggressive expressions. Performance between aggressive, neutral and distressed were not significantly different, nor were the performance between friendly and very aggressive macaques.

Table 5.

Child only macaque GLMM

Full vs. null	*N*	χ2	df	*p*
	1580	521.67	12	**<0.001**
Attachment to pets				

High vs. Low	-0.082	0.186	-0.44	0.659
Typical Cruelty				
High vs. Low	0.284	0.324	0.874	0.382
Malicious Cruelty				
High vs. Low	-0.238	0.381	-0.625	0.532
Dog Ownership:				
Yes vs. No	0.141	0.196	0.72	0.472
Gender				
Female vs Male	-0.141	0.155	-0.91	0.363
Age				
4-6 vs. 7-8	0.248	0.18	1.377	0.169
4-6 vs. 9-10	0.263	0.199	1.319	0.187
Expression				
Friendly vs. Neutral	-1.772	0.835	-2.122	**0.034**
Friendly vs. Distressed	-3.289	0.869	-3.786	**<0.001**
Friendly vs. Aggressive	-3.484	0.867	-4.018	**<0.001**
Friendly vs. Very Aggressive	-0.942	0.824	-1.143	0.253
Neutral vs. Distressed	-1.513	0.874	-1.731	0.083
Neutral vs. Aggressive	-1.708	0.875	-1.953	0.051
Neutral vs. Very Aggressive	0.832	0.835	0.997	0.319
Distressed vs. Aggressive	-0.203	0.903	-0.224	0.822
Distressed vs. Very Aggressive	2.337	0.865	2.701	**0.007**
Aggressive vs. Very Aggressive	2.538	0.866	2.931	**0.003**

Note: Results of the GLMM testing the difference in children's abilities to correctly assess the macaques emotional state based on individual differences and type of facial expression. Bold values show statistically significant P values ($p < 0.05$).

2.3.5. How will intergenerational effects between a child and their parent influence their ability to accurately perceive human and Barbary macaque facial expressions and their behaviour towards them.

A Spearman's rank-order correlation was run to determine the relationship between children and their parent's ability to accurately perceive human and macaque facial expressions in the questionnaire and practical task. For ability to perceive human facial expressions there was no correlation between the child and their parents mean score on the questionnaire (r_s (66) = .0.27, p = .830). For ability to perceive macaque facial expressions; there was no correlation between the child and their parents mean score on the questionnaire (r_s (66) = -.0.30, p = .811) and no

correlation between the child and their parents mean score on the practical task (r_s (66) = -0.134, p = .284). This means intergenerational effects had no significant influence on children's ability to accurately perceive human and macaque facial expressions.

A Spearman's rank-order correlation was run to determine the relationship between children and their parent's distance willing to approach the macaque models in the practical task. There was no correlation between the child and their parent's mean distance willing to approach the macaques in the practical task (r_s (66) = .010, p = .935), again showing that intergenerational effects had no significant influence on a child behaviour towards the macaques.

2.3.6. How facial expression perception influences participant willingness to approach macaques based on both perceived expression and actual expression?

A Wilcoxon signed-rank test showed that in students and adults, their perception of the macaque's facial expressions did elicit a statistically significant change in distance willing to approach the macaque (Table 6). In both age groups, participants got statistically significantly closer to distressed macaques (Adults = 4.07 ± 1.6m; Students = 3.33 ± 1.25m) than they chose to approach macaques they perceived to be scared (Adults = 4.91 ± 1.33m; Students = 4.33 ± 1.23m). Similarly both age groups got statistically significantly closer to aggressive (Adults = 3.83 ± 1.54m; Students = 3.23 ± 1.16m) and very aggressive macaques (Adults = 5.08 ± 1.18m; Students = 4.58 ± 1.30m) than they chose to approach macaques they perceived to be angry (Adults = 5.55 ± 0.71m; Students = 5.10 ± 1.03m). Both age groups approached friendly macaques from statistically significantly further away (Adults = 4.15 ± 1.66m; Students = 3.56 ± 1.27m) than they chose to approach macaques they perceived to be happy (Adults = 3.18 ± 1.88m; Students = 2.09 ± 1.37m). Adults approached neutral macaques from statistically significantly further away (4.34 ± 1.44m) than macaques they perceived to be okay (3.62 ± 1.56). Students approached neutral macaques statistically significantly closer (3.90 ± 1.24m) than macaques they perceived to be okay (4.33 ± 1.23m).

Table 6.

Wilcoxon signed ranks test for adults and students' distance willing to approach

macaques based on their perceived and actual facial expressions.

	Adult	Holm-B		Student	Holm-B	
Actual vs. Perceived	*Z*	*a*	*P*	*Z*	*a*	*P*
Friendly - Happy	-5.515	0.005	**<0.001**	-5.502	0.010	**<0.001**
Distressed - Scared	-4.435	0.006	**<0.001**	-4.806	0.013	**<0.001**
Neutral - Okay	-5.038	0.006	**<0.001**	-2.582	0.050	**0.010**
Aggressive - Angry	-5.971	0.007	**<0.001**	-5.752	0.017	**<0.001**
Very Aggressive - Angry	-3.726	0.008	**<0.001**	-3.903	0.025	**<0.001**

Note: Adjusted Holm-Bonferroni alpha for each p value included.

2.3.7. How does perception of macaque facial expressions differ between the questionnaire and practical tasks?

A Wilcoxon signed-rank test of all ages (N = 183) found no significant difference between the questionnaire and practical tasks for ability to accurately assess distressed (z = -0.826, $p = 0.409$), neutral (z = -0.495, $p = 0.620$), aggressive (z = -1.000, $p = 0.317$) or very aggressive (z = -0.342, $p = 0.733$) macaque facial expressions. A significant difference was found between the questionnaire and practical task for ability to accurately assess friendly macaque facial expressions (z = -7.265, $p < 0.001$), meaning participants were more able to accurately assess friendly macaque facial expressions in the practical task (0.69 ± 0.46) than the questionnaire (0.38 ± 0.29).

When splitting the data into the three age groups, a Wilcoxon signed-rank test found statistically significant differences in each age groups ability to accurately assess friendly facial expressions between the more accurate practical task (child = 0.77 ± 0.43, student = 0.66 ± 0.48, adult = 0.62 ± 0.49) and questionnaire (child = 0.50 ± 0.26, $p < 0.001$; student = 0.27 ± 0.25, $p < 0.001$; adult = 0.30 ± 0.27, $p < 0.001$). As well as this, the Wilcoxon signed-rank test found significant differences in student's ability to accurately perceive aggressive macaques in the questionnaire (0.07 ± 0.14) and practical task (0.00 ± 0.00, $p = 0.004$). For non-significant results and Bonferroni- Holm adjusted alpha values, see Table 8.

Table 8.

Wilcoxon signed ranks test for child, students and adult's ability to assess macaque facial expressions between the practical and questionnaire tasks.

Practical vs. Questionnaire	Child	Holm-B		Student	Holm-B		Adult	Holm-B	
	Z	*a*	*P*	*Z*	*a*	*P*	*Z*	*a*	*P*
Friendly	-4.411	0.004	**<0.001**	-4.225	0.003	**<0.001**	-3.995	0.004	**<0.001**
Distressed	-0.891	0.008	0.373	-0.100	0.025	0.921	-1.989	0.005	0.047
Neutral	-1.132	0.006	0.258	-0.228	0.013	0.819	-0.115	0.017	0.908
Aggressive	-0.314	0.010	0.754	-2.919	0.004	**0.004**	-0.053	0.050	0.958
Very Aggressive	-2.239	0.005	0.025	-0.929	0.006	0.353	-0.919	0.007	0.358

Note: Adjusted Holm-Bonferroni alpha for each p value included.

When splitting the data by gender, a Wilcoxon signed-rank test found significant differences in both male and female ability to accurately assess friendly facial expressions between the more accurate practical task (Male = 0.71 ± 0.46, Female = 0.69 ± 0.47) and questionnaire (Male = 0.41 ± 0.28, $p < 0.001$; Female = 0.36 ± 0.28, $p < 0.001$). For non-significant results and Bonferroni- Holm adjusted alpha values, see Table 9.

Table 9.

Wilcoxon signed ranks test for Male and Female ability to assess macaque facial expressions between the practical and questionnaire tasks.

Note: Adjusted Holm-Bonferroni alpha for each p value included.

Practical vs. Questionnaire	Male	Holm-B		Female	Holm-B	
	Z	*a*	*P*	*Z*	*a*	*P*
Friendly	-4.065	0.005	**<0.001**	-6.061	0.006	**<0.001**
Distressed	-0.383	0.0125	0.701	-1.196	0.007	0.232
Neutral	-1.388	0.006	0.165	-0.238	0.025	0.812
Aggressive	-0.88	0.008	0.379	-0.618	0.01	0.537
Very Aggressive	-0.327	0.017	0.744	-0.183	0.05	0.855

2.3.8. How does behaviour towards macaque facial expressions differ between the questionnaire and practical tasks?

A Wilcoxon signed-rank test showed that both students and adults, on average, got statistically significantly closer to macaques in the practical task compared to the questionnaire task. Their distance willing to approach the macaques in the practical task (Adults = 3.56 ± 1.26m, Students = 2.86 ± 0.76m) did statistically significantly differ from the distance willing to approach in the questionnaire (Adults = 3.87 ± 1.11m, $p = 0.007$; Students = 3.51 ± 0.77m, $p < 0.001$). In both age groups, participants got statistically significantly closer to friendly macaques in the practical task (Adults = 3.21 ± 1.65m; Students = 2.05 ± 1.09m) compared to how close they chose to approach the friendly macaques in the questionnaire (Adults = 3.78 ± 1.40m, $p = 0.001$; Students = 3.36 ± 0.99m, $p < 0.001$). Students got statistically significantly closer to distressed macaques in the practical (2.05 ± 1.09m) than distressed macaques in the questionnaire (3.36 ± 0.99m, $p < 0.001$). Students also approached aggressive macaques statistically significantly closer in the practical (2.76 ± 0.83m) than aggressive macaques in the questionnaire (3.22 ± 0.91m, $p = 0.001$). For non-significant results and Bonferroni- Holm adjusted alpha values, see Table 10.

Table 10.

Wilcoxon signed ranks test for adults and students' distance willing to approach macaques between the practical and questionnaire tasks.

	Adult	Holm-B		Student	Holm-B	
Practical vs. Questionnaire	*Z*	*a*	*P*	*Z*	*a*	*P*
Friendly	-3.27	0.006	**0.001**	-5.341	0.005	**<0.001**
Distressed	-2.335	0.008	0.02	-4.776	0.004	**<0.001**
Neutral	-1.982	0.013	0.048	-1.55	0.017	0.121
Aggressive	-1.097	0.05	0.272	-3.233	0.006	**0.001**
Very Aggressive	-2.177	0.01	0.029	-1.228	0.025	0.219
Average	-2.721	0.007	**0.007**	-4.576	0.005	**<0.001**

Note: Adjusted Holm-Bonferroni alpha for each p value included.

A Wilcoxon signed-rank test showed that both males and females, on average, got statistically significantly closer to macaques in the practical task compared to the questionnaire task. Their distance willing to approach the macaques in the practical (Males = 2.83 ± 0.92m, Females = 3.40 ± 1.16m) did statistically significantly differ from the distance willing to approach in the questionnaire (Males = 3.35 ± 0.92, p = 0.001; Females = 3.84 ± 0.98, p < 0.001). In both genders, participants got statistically significantly closer to friendly macaques (Males = 2.10 ± 1.39m; Females = 2.92 ± 1.55m) and distressed macaques (Males = 2.29 ± 1.37m; Females = 2.99 ± 1.55m) in the practical task compared to how close they chose to approach the friendly macaques (Males = 3.30 ± 1.09m, <0.001; Females = 3.71 ± 1.29m, p <0.001) and distressed macaques (Males = 3.04 ± 1.10, p = 0.001; Females = 3.54 ± 1.29, p = <0.001) in the questionnaire. For non-significant results and Bonferroni- Holm adjusted alpha values, see Table 11.

Table 11.

Wilcoxon signed ranks test for males and females' distance willing to approach macaques between the practical and questionnaire tasks.

	Male	Holm-B		Female	Holm-B	
Practical vs. Questionnaire	*Z*	*a*	*P*	*Z*	*a*	*P*
Friendly	-3.868	0.004	**<0.001**	-4.934	0.005	**<0.001**
Distressed	-3.208	0.006	**0.001**	-3.953	0.005	**<0.001**
Neutral	-1.126	0.025	0.260	-2.410	0.010	0.016
Aggressive	-1.234	0.017	0.217	-2.660	0.008	0.008
Very Aggressive	-0.778	0.005	0.437	-2.286	0.013	0.022
Average	-3.365	0.007	**0.001**	-4.148	0.006	**<0.001**

Note: Adjusted Holm-Bonferroni alpha for each p value included.

Discussion

This study explored the developmental progression of how humans perceive human and Barbary macaque facial expressions and how this perception affects their behaviour towards Barbary macaques. The study used a self-report questionnaire and practical task to explore the influence of age, gender and child specific individual differences on facial expression perception between species and behaviour. It was found that humans are unable to accurately perceive Barbary macaque facial expressions, and that this ability does not improve with age as found with human facial expressions. The only factor found to influence human ability to perceive macaque facial expressions was the type of expression. Younger participants were found to get significantly closer to the macaques, with male children more often approaching aggressive macaques.

Aim 1

The first hypothesis aimed to assess whether human accuracy of facial expression perception is determined by the species perceived, type of expression, age, gender, intergenerational effects or behaviour towards animals. It was found that the species significantly impacted participant ability to accurately perceive facial expressions - humans were more accurate in their ability to perceive human facial expressions in our study than they were able to perceive Barbary macaque facial expressions. Accuracy was also affected by the type of expression, with humans more able to accurately perceive happy than neutral and angry human facial expressions. For macaques, participants were more able to accurately perceive neutral, friendly and very aggressive facial expressions than aggressive and distressed expressions. Participant ability to accurately perceive human facial expressions increased with age, but participant age group had no significant effect on human ability to accurately perceive Barbary macaque facial expressions. Gender had no significant effect on human ability to perceive human nor macaque facial expressions. In children, intergenerational effects and attitude towards animals also had no significant effect on participant ability to accurately perceive Barbary macaque facial expressions.

In line with extensive research into the human development of perceiving their own species facial expressions (Batty & Taylor, 2006), it was found that ability

increased with age. More specifically, 4-6-year-olds were the least accurate at perceiving human facial expressions, with accuracy levels gradually increasing and reaching their peak at the 18-22-year-old student group. This follows the 'inverted U-shape trajectory' as commonly reported (Williams et al., 2009). Looking at each expression separately, it was found that happy human expressions were the most accurately recognised and were significantly easier to accurately perceive than neutral and angry facial expressions. In conjunction with previous research (Gao & Maurer, 2009) our 4-6-year-old participants had adult-like accuracy levels in perceiving happy facial expressions. Both neutral and scared expression recognition showed a gradual improvement with age, especially between 4-10 years of age. In particular, 4-6-year-olds poorly performed in the neutral expression category, averaging at 50% accuracy but improving to near adult-like accuracy levels by 9-10 years of age. Child perception of neutral expressions are under-researched, but Rodger, Vizioli, Ouyang and Caldara (2015) similarly found a steep increase in improvement between the youngest and oldest age group for their neutral category; suggesting that early difficulty is due to a general bias to attend to more emotive faces (Leppänen & Nelson, 2009). Angry expression recognition was stable throughout child participants, with ability only increasing in the student and adult groups. This can be explained by previous research which found that a child's ability to perceive expressions of anger continues to improve even after 10 years of age (Gao & Maurer, 2010; Thomas, De Bellis, Graham & LaBar, 2007).

Based on past research (Lawrence et al., 2015) it was hypothesised to find gender differences in participant ability to perceive human facial expressions. However, it was found that gender had no significant effect on participant ability to accurately perceive human facial expressions. It may be important to note here that this result takes into account all of the participants, and in the adult participant group there was a distinct lack of males as the sample mainly consisted of the child participants mothers. Because of this, a second test was ran using only the child participants who had an even gender split, however there were still no significant gender differences in ability to perceive the human facial expressions. Therefore, this study finds evidence to support the past studies which suggest male and females perform equally well in emotion recognition tasks (Hall & Matsumoto, 2004; Herba, Landau, Russell, Ecker, & Phillips, 2006).

For human perception of Barbary macaque facial expressions, it was found

that both age and gender had no overall significant impact on perception accuracy in either the practical or questionnaire task. However, the GLMM did find a significant increase in ability to perceive macaque expressions between 4-6-year old children and the student and adult group. It is possible that this is due to the 4-6-year-old children having a poorer understanding of facial expressions as a whole, regardless of species, so they performed slightly worse than other participants. Research does suggest that the recognition of facial expressions improves between 6 and 15 years of age into adulthood; whilst children between 3-6 years of age are improving their ability at interpreting reactions of emotional behaviour and emotions instead (Montirosso, Peverelli, Frigerio, Crespi & Borgatti, 2010; Widen & Russell, 2003; Vicari, Reilly, Pasqualetti, Vizzotto, & Caltagirone, 2000). As the GLMM intercept was non-significant, it is still safe to draw the conclusion that ability to perceive Barbary macaque facial expression does not improve with age.

In support of research from Maréchal et al. (2017), the only factor in our study that was found to influence ability to accurately perceive macaque facial expressions was the type of expression. In particular it was found that humans were more accurate at perceiving neutral, friendly and very aggressive facial expressions than they were at perceiving aggressive and distressed expressions. Maréchal et al. (2017) found that participants were more accurate at perceiving neutral expressions followed by aggressive expressions, performing the worst for distressed and friendly expressions. Mostly the pattern is the same, what stands out is that in Maréchal et al. (2017) friendly expressions were one of the most difficult to accurately perceive, whereas in this study it was found that friendly expressions were amongst the most accurately perceived. When looking at our data in more detail, the questionnaire confusion matrix shows high percentages (53.6%, 47.4% and 53.4%) of all three child participant age groups accurately perceiving the friendly macaques as happy. However, the same cannot be said for students and adults with a 26% and 30.4% accuracy percentage, misperceiving the friendly macaques to be ‘okay’. At first glance this looks as if children possess a greater ability to perceive friendly macaque facial expressions. However, the more likely reasoning may be possible that children select ‘happy’ more often than the other expression choices, regardless of the expression being viewed. Further analysis found that in the questionnaire, 31% of the children’s responses to how they thought the monkey was feeling was the option of ‘happy’, compared to 22% of students and 21% of adults and when only 20% of

the images viewed were friendly macaques. Therefore, children had more chance of correctly perceiving friendly macaques as happy due to the higher frequency of that response and since Maréchal et al. (2017) only studied adults, there are differences in the results.

In children specifically, attachment to pets, cruelty levels, dog ownership, intergenerational effects, age and gender had no influence on their ability to perceive macaque facial expressions. This tells us that the facial expression experience gained from a child's attachment to pets and dog ownership, is species-specific. Similarly, Guo et al. (2019) found that dog owners performed significantly better than non-dog owners only with neutral and positive dog facial expressions, but it had no impact on participants ability to perceive the rhesus macaques in their study. This means that in order for humans to improve their ability to perceive Barbary macaque facial expressions, they need more direct experience with Barbary macaques themselves through images, videos or real-life interactions. Empathy was also thought to potentially influence child perception of macaque facial expressions, as empathy (as well as dog ownership) has been found to influence ability to perceive dog facial expressions (Kujala et al., 2017), but see also Meints et al. (2018) for evidence to the contrary (no effects of dog ownership). Empathy was measured in the form of cruelty levels, however, our sample had consistently low levels of cruelty reported so no significant differences in questionnaire performance were shown. This could be due to either a potential social desirability effect in parents not wanting to disclose their child's cruelty behaviour, poor questionnaire design, or a lack of diversity in the child sample.

Aim 2

The second study aim questioned whether age, gender and human perception of Barbary macaque facial expressions will influence participant intended proximity to approach, feed or take a selfie with the macaques. It was found that age significantly influenced participant intended proximity to approach in children, with younger participants getting significantly closer to the macaques. Gender had no significant effect on distance willing to approach in children but did impact the macaque which children chose to approach. There were no significant differences between students and adults' distance willing to approach in the stimuli in the practical, but males approached closer than females. How participants perceived the

macaques significantly impacted their distance willing to approach, in that adults got significantly closer to the distressed, aggressive and very aggressive macaques than they had chosen to approach the macaques they perceived to be scared and angry.

The concerning approach behaviour demonstrated by the child participants in our study emphasises how young male children are the most at risk of dangerous animal interactions, such as monkey bites. Children aged 4-6 and 7-8 years old were found to approach the macaques at significantly closer distances than children aged 9-10 years old. The younger children on average approached the macaque models at a distance of 1.3m, the distance equivalent to three child footsteps. As well as this, 48% of the male children chose to approach the aggressive or very aggressive macaque, compared to 32% of females. Over half of the female children instead chose to approach the safer (but still potentially dangerous) neutral and friendly macaques. Therefore, younger children (4-8 years old) approach macaques at closer distances, whilst males may approach more dangerous macaques; meaning young males may be at the greatest risk of a dangerous human-animal interaction. This may explain why case studies have previously found high rates of animal bites in young males (Ichhpujani et al., 2008; Osaghae, 2011). During the practical task, it was noted by the researcher that one child in the study said they liked the very aggressive macaque because it had its ‘teeth out’, with two other children commenting on the very aggressive macaques ‘open mouth’ as a reason for approaching. Research into dog facial expressions used eye tracking to find that when children look at aggressive dog faces, they do not follow the typical eye-nose-mouth scan pattern, they focus on the mouth area looking at the teeth (Meints, Allen, & Watson, 2010). It may be possible that because of this localised focus on teeth and upturned mouth corners, children tend to misinterpret angry expression as happy ones. This potentially explains why the children in our study chose to approach the very aggressive macaques at high rates, because they perceived them as happy. This is reinforced by a larger percentage of children, 32.4%, in the practical task perceiving the very aggressive macaque as ‘happy’.

Adults and students approached the macaques in the practical task, on average, from further away than the child participants chose to approach the macaques. However, it is not possible to directly compare these results, as children were only asked to approach one macaque if they wanted too, whereas adults and students were asked to choose how close they would approach all five macaques.

When comparing the adult and student practical approach distances averages, students approached closer at 2.86m compared to adults 3.56m, but there was no significant difference between the two. When looking at each expression individually, it was found that students approached friendly, distressed and aggressive macaques significantly closer than adults did. The remaining neutral and very aggressive macaques were approached by both adults and students equally and from the furthest distances. This is potentially due to the macaques most perceived to be 'angry' by students in the practical were the neutral (51.1%) and very aggressive (60%) macaque. Therefore, students may only willingly be more risk taking for the macaques they perceive as 'safer', avoiding the more dangerous macaques and approaching them at an 'adult-like' distance. Therefore, both the adult and student participants clearly displayed behaviour showing them to be conscious of their safety when approaching the macaques in the study. However, in the questionnaire, the aggressive and distressed macaques were the two that participants chose to approach at the closest distances. This highlights how humans cannot trust their abilities to interpret an animal's mood via their facial expression in wildlife interactions. This is emphasised by further questionnaire results. The distances that participants chose to approach the distressed, aggressive and very aggressive macaques were significantly closer than the distances participants chose to approach for the macaques they perceived to be scared and angry. Enforcing that humans are unable to behave in a safe manner as their perception ability is unreliable, so it may benefit humans more so to stay a safe distance away at all times. This may be especially the case for young males due to the significant differences for gender found, in that males approached closer than females at a distance comparison of 2.68m to 3.45m respectively.

Aim 3

Hypothesis 3 investigated whether human self-reported behaviour will accurately represent simulated real-life perception of and behaviour towards Barbary macaques. It was found in all participants there were no significant differences between the questionnaire and practical task for their ability to accurately perceive distressed, neutral, aggressive or very aggressive Barbary macaque facial expressions. Participants were significantly more accurate in perceiving the friendly macaques in the practical task compared to the questionnaire. On average, it was

found that student and adult participants got significantly closer to macaques in the practical than they reported themselves to in the questionnaire. In particular, adults got closer to friendly macaques in the practical, whilst students got closer to friendly, distressed and aggressive macaques in the practical when compared to the questionnaire.

When comparing participant approach behaviour, it was found that on average students and adults got closer to the macaques in the practical task than the questionnaire task. Students approached on average 65cm closer in the practical compared to the adults approaching 31cm closer on average. Yet again participants only approached significantly closer the macaques that they perceived to be non-threatening. Students approach the friendly, distressed and aggressive macaques at closer distances because they perceived these them to be happy or okay. Whilst adults only approached the friendly macaques at closer distances. An important difference to note when comparing the practical and questionnaire images is that the practical task images had to have bodies added to the macaque faces in order to present participants with a realistic life-size macaque image. Because in this study the effects of body gestures on facial expression perception were not investigated, the same neutral macaque body was applied to each face. It is possible that the aggressive macaque may have been perceived as ‘okay’ frequently by students because it had a ‘neutral’ body. This may be since the aggressive macaque was the most difficult for participants to accurately perceive in the study, so they resorted to using body cues. However, student and adult participants accurately perceived the very aggressive macaque as angry despite it having a ‘neutral’ body. Student and adult participants also behaved the most appropriately and consistently towards the very aggressive macaques. There were no differences in how they behaved between the questionnaire and practical and while most participants consistently chose not to approach the macaques, the remaining who did still only approached from on average of 4-5m away.

In all participants, there was no difference in their ability to perceive distressed, neutral, aggressive or very aggressive facial expressions between the practical and questionnaire. Participants were, however, more accurate in perceiving the friendly macaque in the practical task compared to the questionnaire. When directly comparing the two it is important to note that there was only one image per expression in the practical whereas the questionnaire had four images per

expression. Therefore, it is possible that if any of the practical images had distinct qualities that influenced their facial expression ratings this would be more noticeable in the data than if it were a questionnaire image. For instance, Clark et al. (2020) found that approach distance and ratings such as ‘cuteness’ and ‘dominance’ were determined by the macaque’s facial characteristics such as baby schema and facial width to height ratio (fWHR). Therefore, if the practical task friendly macaque model had higher baby schema and smaller fWHR compared to the questionnaire friendly macaque images then participants may have viewed it as cuter or more subordinate influencing their facial expression perception and approach behaviour (Clark et al., 2020).

An important aspect of this study was to highlight the differences between questionnaire and self-report research in comparison to a simulated real-life interaction in a lab. The main advantages to the practical study were that it gave participants an accurate depiction of the average size of a macaque as well as the distance between them. From the research it can be concluded that the questionnaire methods are ecologically valid when categorising the perception of facial expressions, but as a significant difference was found between practical and questionnaire distance, a practical experiment may yield more accurate results for distance measures. This is most likely caused by participants either not being able to accurately visualise a 5m distance or being more attracted to a physical stimulus. Despite the increased accuracy by this study incorporating a practical task as well as questionnaire element it still neglects an important aspect of human-animal interactions, that being the animal. As pointed out by Clark et al. (2020) the macaques themselves greatly influence human-animal interactions, they may initiate or avoid an interaction. Even though human intended approach behaviour does not relate to real-world observed human-macaque proximity (Clark et al., 2020), it is still valuable to provide insight to how these interactions may play out.

Limitations

One of the main limitations of the study are the images used in the questionnaire. High quality images of Barbary macaques displaying a range of facial expressions can be difficult to obtain, especially ones that include a clear image of the macaque’s body without it being covered by branches or other primates. However, whilst face only images are of easier access for these wild animals, they

may not show the full behavioural intentions of the macaque. In basic human facial expression research, it is often practice to utilise face only images as done in this study. However, there is growing evidence to suggest that emotional body language is influential in expression perception, that both the face and the body contribute to the overall emotional state of the individual (Meeren, van Heijnsbergen & de Gelder, 2005; Meints et al., 2018). In addition to facial expressions and body gestures, in human research emotional voices also aid in the whole-body communicative expression (Van den Stock, Righart & de Gelder, 2007). Therefore, macaque vocalisations may influence expressions as well. However, in order to keep our research controlled and reliable, focusing solely on the expression of the macaque, in conjunction with past research on macaque facial characteristics (Clark et al., 2020) makes up a big part of the picture as to how humans perceive primates. This study also utilised a control; face only human images which still yielded high levels of facial expression perception accuracy in participants.

Future research into human perception of primate facial expressions, should expand on our findings to include face and body research as discussed above as well as exploring primates other than Barbary macaques. Future research could also focus on the impact of interventions on human behaviour towards animals. Similar to research on dogs (Meints et al., 2018), participants could take part in longitudinal studies to test the effects of not only facial expression recognition intervention but also behaviour intervention. For instance, being taught about what facial expressions could mean about an animal, the signals to recognise and how to appropriately respond. From a developmental perspective, investigating and comparing the abilities and behaviour of typical children and those with autism spectrum disorder (ASD) could yield interesting results on a potentially more at-risk group. As one of the main characteristics of ASD is the impairment of social and emotional abilities, in particular deficient communication via facial expressions (Sato, Toichi, Uono & Kochiyama, 2012).

Conclusion

Overall this research concludes that there are no developmental effects on the human ability to perceive Barbary macaque facial expressions. The findings from this research do however highlight the need to train children and adults on facial

expressions of macaques. Furthermore, these results can be utilised to help improve the safety of wildlife tourism. This study has highlighted that young male children especially are at risk of behaving inappropriately towards aggressive macaques. Young children got significantly closer to the macaques whilst males chose to approach aggressive and very aggressive macaques most often. While this may not happen in real life, animal bite statistics suggest that this is a realistic possibility. Because of this, educational techniques should be targeted to such groups. Even though no intergenerational effects between parent and child behaviour were found, parental education is still important. During family holidays to wildlife tourism destinations, it is the parents who make the decision to attend sites where wild animals, including primates, are located or where human-animal interactions are advertised and marketed. In some instances, also, it may be the parents who encourage children to pose with wild animals for photographs, as tourists often put themselves and their children in danger to get the perfect wildlife selfies (Jones, 2014; Pearce & Moscardo, 2015).

As well as educating parents, making greater use of signs which emphasise that humans should stay at a safe distance from wild animals at all times, as this research shows humans cannot accurately assess the emotional state of a primate nor behave appropriately. It may also be advantageous to include illustrations as well as informative text on signs (Marschall, Granquist & Burns, 2017) as children cannot accurately read connected text until the age of six (McNaughton, Phillips, & MacDonald, 2000); and it was the children aged 4-8 years old who were the most at risk in our study. It may also be beneficial for signposts to illustrate a safe distance for people during wildlife tourism, or use distance markers on the ground, instead of only stating that 5-10m is a safe distance. As our study results also show that participants may not have an accurate perception of what 5-10m is, as they approached closer in the practical task than what they did in the questionnaire.

In summary, the present study found that humans are unable to accurately perceive Barbary macaque facial expressions, and that this ability does not improve with age as found with human facial expressions. The only factor found to influence human ability to perceive macaque facial expressions was the type of expression. As the developmental approach has shown to not influence the way humans perceive primate expressions, other approaches now need to be investigated to further improve our understanding of human-animal interactions. This is essential

knowledge, as if we can find the correct ways of educating people, we can hope to prevent monkey bites and improve the wildlife tourism experience for all ages.

Chapter 3

Understanding Human Perception of Primate Facial Expressions and its Impacts on Human-nonhuman Primate Interactions: The Impact of Experience.

3.1. Introduction

Close human-animal interactions raise serious concerns for human safety and animal welfare. Negative interactions can occur by humans misinterpreting an animal's facial expression and therefore attributing an inaccurate inferred emotional state of the animal; causing them to behave in inappropriate ways (Maréchal et al., 2017). Research has often reported this behaviour in humans and acting inappropriately towards dogs, ignoring and misinterpreting their expressions of stress resulting in an aggression response from the animal (Meints et al., 2018). In this study, the above work is extended to better understand interspecies communication by testing human perception of and behaviour towards different capuchin monkeys' facial expressions. This study also explores cross-cultural differences by comparing two populations, native citizens to Argentina, where capuchins are native, and the United Kingdom. This research will also provide insights into the Universality hypothesis and expertise hypothesis.

Universality versus Expertise

The Universality hypothesis suggests six basic emotions are expressed by similar facial expressions across closely related species (Ekman, 1992; Ekman, 1993). First proposed by Darwin (1873) it is suggested that animals, especially closely related species, share aspects of cognition, emotion, and behaviour, due to shared ancestry. Humans and primates both have the ability to perceive and infer emotional valence and social context in conspecifics and respond to them appropriately (Parr, 2001). It is unsure, however, if this ability is limited to within-species emotion perception, or whether this ability extends to include other species. The Universality hypothesis would suggest so, however, some facial expressions may seem morphologically similar in human and nonhuman primates in appearance,

but they actually stem from different emotional states (Leopold & Rhodes, 2010; Maréchal et al., 2017).

Research into the theory has come with conflicting results. Waller, Bard, Vick, and Pasqualini (2007) found that both naive and familiar participants judged perceived emotional valence similarly between chimpanzee and human facial expressions. Pascalis, de Haan, and Nelson (2002) found that 6-month old human infants could recognise both individual monkey and human faces equally well. However, by 9-months the human infants, as well as human adults, could no longer recognise the individual monkey faces as well as they could recognise individual human faces. Whilst in Barbary macaques it has been found that they have a similar facial morphology to other primates, however, they still seem to have species-specific facial expressions (Julle-Danière et al., 2015).

The Universality hypothesis states that expressions are recognised universally across cultures, however, Nelson and Russel (2013) found variances of culture and language in the percentage of observers who matched a face with the predicted emotion, therefore it was not universal. Cultural differences in the form of an in-group advantage that exists in facial expression recognition have been frequently reported (Jack, Garrod, Yu, Caldara & Schyns, 2012; Yan, Andrews, Jenkins & Young, 2016). For instance, Dailey et al. (2010) found that Japanese and U.S participants were better than the other at classifying facial expressions from members of the same culture. There is a plausible link that the reason specific cultures are superior at perceiving their own cultures facial expressions is due to frequency of exposure. This has been explored extensively in terms of the own-race bias, that across cultural and racial groups unfamiliar faces from other races are usually remembered more poorly than faces from someone's own race (Meissner & Brigham, 2001). Calvo, Gutiérrez-García, Fernández-Martín and Nummenmaa (2014) have reported that efficiency and accuracy to facial expression recognition is impacted by familiarity in the form of the frequency of exposure in everyday life. Therefore, if a group of individuals have greater exposure to capuchin monkeys in their everyday life via seeing them in their natural habitat or in media, they may be more accurate in their ability to perceive capuchin facial expressions.

Maréchal et al. (2017) measured such a difference between novice, exposed and experienced participants ability to accurately perceive Barbary macaque facial expressions. They found that simply exposing participants to images of macaque

facial expressions with descriptions improved the participants ability to better perceive neutral and distressed faces when compared to inexperienced participants. Here, a similar design was used in terms of asking participants how they think primates in images are feeling, but with no physical form of monitored prior exposure. Instead UK natives who will have little to no exposure to Capuchins were the 'inexperienced' group and Argentinian citizens who may have more natural exposure to their native Capuchin were the 'exposed' group. Maréchal et al. (2017) also included an 'experienced' participant group, who were more accurate in perceiving the expressions, especially for aggressive faces. The idea that experience is required to accurately perceive facial expressions in other species is also explained by the expertise hypothesis.

The expertise hypothesis suggests the mechanisms involved in face processing are also engaged by objects for which people have become experts in (Rezlescu, Barton, Pitcher & Duchaine, 2014). Such objects include non-human animals. For instance, people can become experts in dog facial expressions, professional dog trainers who were taught about dog facial expressions were more accurate in recognising dogs' emotions based on their behaviour than dog owners (Wan, Bolger & Champagne, 2012). Therefore, this hypothesis can be applied to individuals who have spent more time with a particular species of primate, and they are better able to recognize that species' facial expressions (Waller, Bard, Vick & Smith Pasqualini, 2007; Dufour, Pascalis & Petit., 2006; Sugita, 2008).

Tourist behaviour towards animals

It has been established in humans and animals that different facial expressions and facial characteristics will elicit varying distances of approach behaviours in humans (Marsh, Ambady & Kleck, 2005; Heuer, Rinck & Becker, 2007; Clark et al., 2020). So not only are varying behaviour towards different types of capuchin expression expected, but a person's experience may also have an influence. For instance, whether they are a tourist or a native to that animals' environment. A study on macaques in Bali and Gibraltar found that the local humans familiar with the monkeys interact with them significantly less than tourists do (Fuentes, Shaw & Cortes, 2007). This is potentially due to the macaques being less of a novelty and the natives being familiar with their undesirable behaviour such as being aggressive, begging and stealing food or property (Beisner et al., 2014). As

further evidence it has been reported that tourists are often seeking close interactions with capuchins, to the extent they often provide them with food which is against the rules of such wildlife parks (Tiddi, Pfoh & Agostini, 2019).

Bodily expressions of emotion

Faces are not usually encountered as isolated objects but as an integrated part of the whole body. Because of this, it has become increasingly more common for human facial expression research to not only look at the effect of faces, but also bodily expressions. Emotional body language has been found to be influential in conveying the overall emotional state of an individual (Meeran, van Heijnsbergen & de Gelder, 2005). A study that explores this in detail comes from Martinez, Falvello, Aviezer and Todorov (2015), for six different expressions, they presented participants with face only, body only and face and body dynamic stimuli. They presented the intact face and body videos after presenting the separated face only and body only videos to prevent participants from recognising them. Overall, they found perceiving the face and body together resulted in the most accurate recognition of emotion. Such research has not yet been explored in terms of the human perception of primate emotions, as it has with dog signalling (Meints, Brelsford & Keuster, 2018). The body of a primate may also have the potential to significantly influence a human's perception of their inferred emotional state, therefore, this was tested. Participant responses were compared for the same capuchin face image both with and without the body, using a similar methodology to that of Martinez et al. (2015).

Aims

In the current study I aim to investigate the effect that exposure to capuchin monkeys has on the human perception of capuchin facial expression by exploring (1) whether human accuracy of capuchin facial expression perception is determined by exposure via country of residence, gender or type of capuchin facial expression; (2) whether exposure via country of residence, gender, age and type of expression will influence human intended approach, feed or take a selfie with the capuchins; (3) how perception of and behaviour towards a capuchin will differ between a face only image and face and body image, and how participant experience with capuchins affects this.

I predict a difference in capuchin facial expression recognition ability and approach behaviour between exposure levels. More specifically, it is predicted that Argentinian participants will be more accurate than UK at perceiving the expressions, whilst UK participants approach the capuchins at closer distances than the Argentinians. I also predict participants will be more accurate in their facial expression perception ability when viewing face and body images compared to face only images. Following this it is expected to develop and provide information to make wildlife tourism safer, with a greater understanding of interspecies communication between levels of exposure to primates.

3.2. Methods

3.2.1. Participants

The study aimed to recruit 200 participants, 100 each from the UK and Argentina, with an equal gender distribution and average age.

A total of 259 participants were recruited for the study. The UK participants were recruited through social media advertising and the University's SONA system. The recruitment of Argentinian participants was done through social media (Twitter, Facebook) and Barbara Tiddi 's network. Of these, 144 UK participants and 4 Argentinian participants, aged between 18 and 21 years old, were not included in the final data analysis due to an unbalanced age distribution between the two countries.

The final total of participants included in the data analysis was 111 participants which were made into three groups; UK novice, Argentinian novice, Argentinian expert. The novice groups were made up of 94 participants without experience of working with or studying capuchin monkeys. These were 56 UK adults comprised of 11 males and 45 females, aged between 22 and 81 years old (M = 43.5, SD = 17.89) and 38 Argentinian adults consisting of 9 males and 29 females, aged between 22 and 67 years old (M = 37.87, SD = 11.54). The remaining 17 participants were Argentinians with experience of working with and / or studying capuchin monkeys; consisting of 3 males and 14 females aged between 24 and 43 years old (M = 35.06, SD = 6.54) (Table 12).

Table 12.

Gender and age distribution and averages for the 111 participants whose data was used for the studies analysis.

	Gender		Age		Total
	Males	*Females*	*Mean*	*SD*	*N*
UK Novice	11	45	43.50	17.89	56
Argentina Novice	9	29	37.87	11.54	38
Argentina Experienced	3	14	35.06	6.54	17

Participants were all nationals of their respective country, currently living and having lived there for more than half their life. Participants were advised not to take part if they had animal-related or monkey-specific phobias. The application was submitted via the University of Lincoln Ethics Application System and ethically approved by the University of Lincoln Human/ Non-Human Research Ethics Committee (approval code: LEAS 2019-0854) (Appendix A2).

3.2.2. Materials

Stimuli

Four independent Capuchin experts reviewed 38 potential images and categorised each using the options, friendly, distressed, aggressive and neutral, indicating how confident they were in each answer. From these 38 images, 15 were selected based on the quality of the image, a mutual agreement in expression category by the experts of at least 75%, and enough of the body visible in the original image. A suitable amount of body visible was categorised as ‘an observable presence of movement in the monkey’. The 15 different images of capuchins used for this study, consisted of 5 neutral, 5 distressed and 5 aggressive facial expressions. The 15 images used were all of different Capuchin monkeys, both male and female and at varying angles; the images were supplied by Barbara Tiddi and Brandon Wheeler (University of Kent) (Appendix F2). Of the 15 images, 9 were chosen to be displayed twice to the participants, once as a face only images, secondly as a face and body image. Every image used, 24 in total, had the background removed using GIMP 2.10.4 with any leaves and branches that crossed over the monkey’s body left in the image. The final image was presented on a white

background.

3.2.3. Procedure

The study was conducted online using Qualtrics software (©Qualtrics2019), version 12/19, and distributed to students at the University of Lincoln via SONA and to the general public via social media. Participants were asked to read an information sheet and provide consent to take part in the study (Appendix B2 and C2). The questionnaire contained demographic questions asking for the participant's age, gender, nationality, country of residence, whether they have had an occupation relating to animals, their experience with capuchin monkeys and how much they like/dislike non-human animals and primates.

Nine of the images (3 from each facial category) were displayed to the participant twice; firstly, as a face only image and then again as a face and body image (Figure 12). The 6 remaining capuchin images (2 from each facial category) were displayed to the participant in-between the 'face only' and 'face and body' images as 'buffer' images; to prevent participants being shown the same capuchin consecutively. For each capuchin image participants were asked to select how they think that monkey was feeling using the options, happy, angry, scared and okay (randomly presented each time). For each image participants were also asked how close they were willing to approach the monkey, approach to feed the monkey and approach to take to a selfie with the monkey; from 0m (touching) to 10m, including an option to not approach. After they completed the questionnaire, participants were fully debriefed and thanked for their time (Appendix D2).

Figure 12.

Example stimuli

Note: An example of a “Face only” and “Face and Body” image used in the questionnaire of the same neutral Capuchin monkey (©Barbara Tiddi and Brandon Wheeler).

3.2.4. Data Analysis

With normally distributed, parametric data one-way and two-way ANOVAs were used using SPSS v26. They tested for any significant differences or interactions between country of residence, age and gender for distance willing to approach as well as number of correct capuchin expressions perceived. For distance willing to approach, an index of distance will be used. From touching (0) to would not approach (11) in increments of 1.

A generalised linear mixed model (GLMM) was used to investigate whether participant ability to accurately assess each capuchin facial expression was predicted by their country of residence (UK or Argentina), gender (male or female), age or the type of facial expression (neutral, distressed or aggressive). Participant ability to recognise facial expressions was binary (1 = yes, 0 = no) whilst experience and expression were categorical. The participants and images identification numbers were included as random factors. The GLMM was run using R studio cloud (©RStudioCloud2020) version 06/20, using the glmer function from the lme4 package (family = “binomial’’). The significance of the full model was compared to the corresponding null model, containing only the dependent variable and the two random factors. Models were checked to assess whether they violated any assumptions, including collinearity (VIF function, all VIF results <4), outliers (Cook’s distance <1, no outlier found), distribution and homogeneity of the residuals (Field et al. 2012).

A Spearman's rank-order correlations was used with SPSS v26 to determine any significant interactions between age and distance willing to approach. For distance willing to approach, an index of distance will be used. From touching (0) to would not approach (11) in increments of 1. The continuous variable of age was not normally distributed, so a non-parametric test was used.

As the data was not normally distributed, Wilcoxon signed ranks tests were used to compare how perception of and behaviour towards the capuchins differed when viewing them as a face only image compared to the full face and body image. This was done using the total number of correct capuchin expressions perceived per expression for the three sets of face only and face and body images. Capuchin experts and novices were compared, buffer images were not included.

3.3. Results

3.3.1. Confusion matrix for all participant perception of capuchins

As shown in Table 13, participants were largely accurate in their ability to perceive capuchin facial expressions, with the majority of non-experienced Argentinians confusing distressed capuchins with 'happy' at 40.50%. Between the non-experienced participants, Argentinians were more accurate at perceiving distressed and aggressive capuchins than UK participants. Experienced Argentinians were the most accurate of all, with accuracy percentages of 84.60%, 52.20% and 66.90%. The neutral capuchin was the most accurate for participants to perceive with an average of 79.13%, followed by aggressive at 57.57% with distressed being the most confused with other expressions at 42.27% accuracy. Despite participants not being shown any friendly macaques, high percentages (8.10% - 40.50%) of participants labelled the distressed and aggressive macaques as feeling happy.

Table 13.

Confusion matrix to show what percentage of participants perceived each capuchin's facial expression to be, split by experience and country of residence.

Country	Actual	Predicted (%)			
		Happy	Okay	Scared	Angry

UK Novice	Neutral	4.9	**76.8**	16.5	1.8
	Distressed	32 .1	18.1	**35.5**	14.3
	Aggressive	11.2	15.2	24.8	**48.9**
Argentina Novice	Neutral	2.3	**76**	19.7	2
	Distressed	**40.5**	10.5	39.1	9.9
	Aggressive	15.1	4.3	23.7	**56.9**
Argentina Experienced	Neutral	4.4	**84.6**	7.4	3.7
	Distressed	22.1	8.1	**52.2**	17.6
	Aggressive	8.1	0.7	24.3	**66.9**

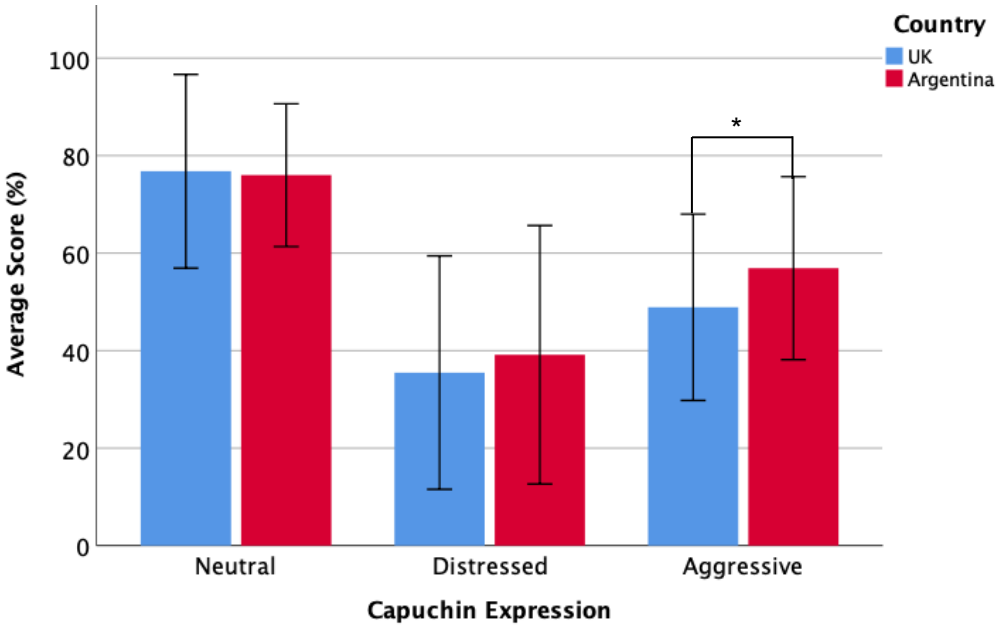
3.3.2. Is human accuracy of capuchin facial expression perception determined by country of residence, gender or type of expression?

A two-way ANOVA was conducted that examined the effect of country of residence and gender on participant ability to accurately perceive capuchin facial expressions in the questionnaire. The main effect of participant gender was not statistically significant (F (1, 90) = 2.498, p = 0.117, partial η2 = 0.027). The main effect of country of residence was not statistically significant either (F (1, 90) = 0.003, p = 0.959, partial η2 < 0.001), nor was there a significant interaction between gender and country of residence on participants' ability to accurately perceive capuchin facial expressions *(F* (1, 90) = 3.030, p = 0.085, partial η2 = 0.033).

A one-way ANOVA found a statistically significant difference between UK and Argentinian participants for aggressive capuchin expressions (F (1,92) = 4.049, p = 0.047, partial η2 = 0.042), showing that Argentinian participants (56.91 ± 18.77) were more accurate in their perception abilities than UK participants (48.88 ± 19.11) (Figure 13). Two further one-way ANOVAs found no differences between participants for neutral expressions, (F (1,92) = 0.45, p = 0.833, partial η2 < 0.001) (UK = 76.79 ± 19.86; Argentina = 75.99 ± 14.64) or distressed expressions, (F (1,92) = 0.484, p = 0.489, partial η2 = 0.005) (UK = 35.49 ± 23.93; Argentina = 39.97 ± 26.50).

Figure 13.

Mean correct score per capuchin facial expression by participant country of residence



Note: The average participant score in percent for ability to accurately perceive neutral, distressed and aggressive capuchin facial expressions; in non-experienced UK and Argentinian participants (error bars 1 SD). * P<0.05, ** P<0.01, *** P<0.001.

As shown in Table 14, country of residence, gender or age did not significantly predict the participants ability to accurately recognise capuchin facial expressions. There was a significant difference in the participants' performance depending on the type of facial expression, with aggressive and distressed expressions being more difficult to accurately perceive than neutral expressions. Performance between aggressive and distressed capuchins were not significantly different.

Table 14.

Capuchin GLMM

Full vs. null	*N*	χ2	df	*p*
	2256	756.36	5	**<0.001**
	Estimate	±SE	*z*	*p*
Intercept	2.296	0.539	4.256	**<0.001**
Country (Adults)				
UK vs. Argentina	0.171	0.159	1.073	0.283
Gender				
Male vs. Female	-0.325	0.19	-1.715	0.086
Age	-0.005	0.05	-0.982	0.326
Expression				
Neutral vs. Distressed	-1.982	0.493	-4.019	**<0.001**
Neutral vs. Aggressive	-1.568	0.504	-3.114	**0.002**
Distressed vs. Aggressive	0.415	0.504	0.823	0.411

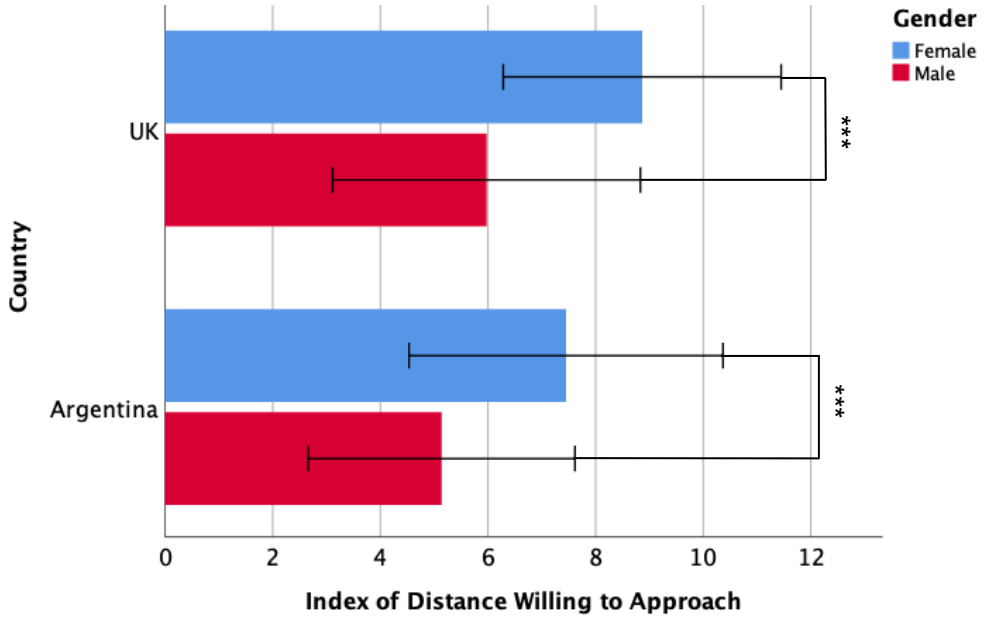
Note: Results of the GLMM testing the difference in participants abilities to correctly assess the capuchins emotional state based on their country of residence, gender, age and type of facial expression. Bold values show statistically significant P values ($p < 0.05$).

3.3.3. Whether country of residence, gender, age and type of expression will influence human intended proximity to approach, feed or take a selfie with the capuchins.

A two-way ANOVA was conducted that examined the effect of country of residence and gender on the average distance willing to approach by participants in the questionnaire (Figure 14). There was a significant main effect of the participants gender on their distance willing to approach (F (1, 90) = 14.230, $p < 0.001$, partial η2 = 0.136). Males approached statistically significantly closer than females (Males = 5.60 ± 2.66m; Females = 8.31 ± 2.79m). There was no main effect of country of residence (F (1, 90) = 2.657, $p = 0.107$, partial η2 = 0.029), nor was there a significant interaction between gender and country of residence on the distance willing to approach (F (1, 90) = 0.177, $p = 0.675$, partial η2 = 0.002).

Figure 14.

Mean distance willing to approach by country and gender

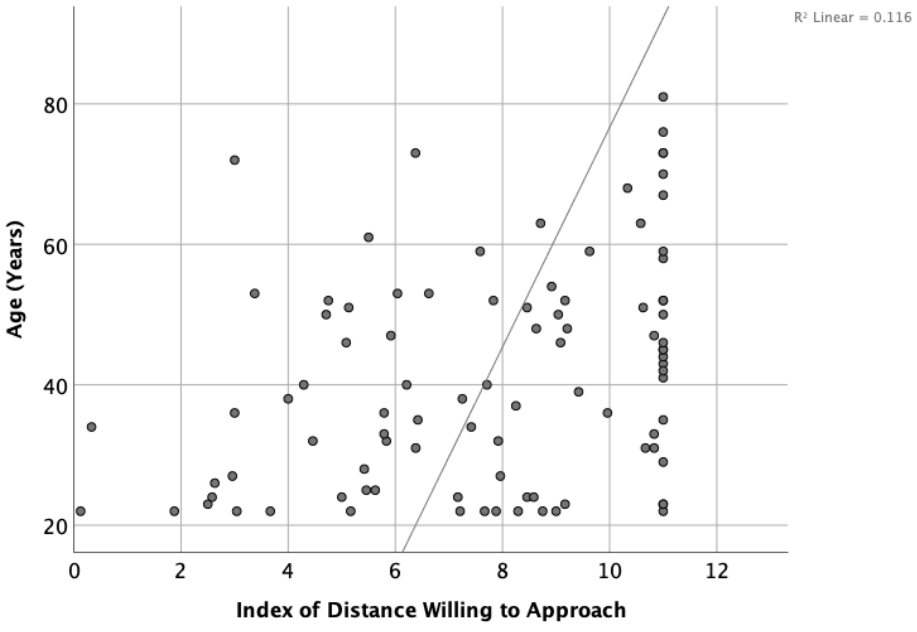


Note: The mean index of participant distance willing to approach the capuchin images, from touching (0) to would not approach (11). Split by gender for non-experienced UK and Argentinians (error bars 1 SD). * P<0.05, ** P<0.01, *** P<0.001.

A Spearman's rank-order correlation was run to determine the relationship between age and distance willing to approach the capuchins (Figure 15). There was a strong, positive correlation between age and distance willing to approach, which was statistically significant (r_s (94) = 0.341, p = 0.001).

Figure 15.

Distance willing to approach by age

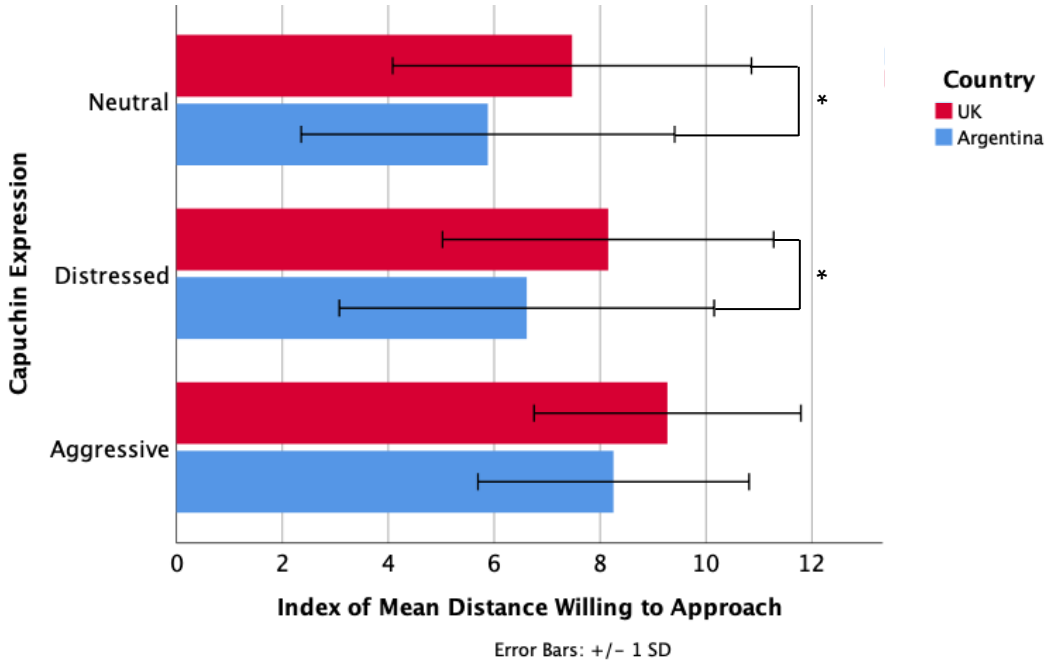


Note: Correlation between non-experienced participants age and an index of their distance willing to approach the capuchins, from touching (0) to would not approach (11).

A series of one-way ANOVAs found a statistically significant difference between UK and Argentinian participants for neutral capuchin expressions, (F (1,92) = 4.98, p = 0.028, partial η2 = 0.051), such that Argentinian participants (5.87 ± 3.48m) chose to approach the capuchins closer than UK participants (7.47 ± 3.39m); for distressed capuchin expressions, (F (1,92) = 5.378, p = 0.023, partial η2 = 0.055), showing that Argentinian participants (6.55 ± 3.51m) chose to approach the capuchins closer than UK participants (8.15 ± 3.13m). A further one-way ANOVAs found no significant differences between participants for aggressive expressions (F (1,92) = 3.375, p = 0.069, partial η2 = 0.035) (UK = 9.27 ± 2.52; Argentina = 8.30 ± 2.56) (Figure 16).

Figure 16.

Mean distance willing to approach by expressions and country



Note: The mean index of distance participants reported being willing to approach the capuchin images, from touching (0) to would not approach (11). Split by facial expression for non-experienced UK and Argentinians. * P<0.05, ** P<0.01, *** P<0.001.

3.3.4. Confusion matrix for all participant perception of capuchins comparing

face only and face and body images

As shown in Table 15, UK participants accuracy in perceiving capuchin expressions improved when shown the face and body image for both distressed and aggressive capuchins by 4.7% and 32.1% respectively. In both non-experienced and experienced Argentinian participants their accuracy in perceiving capuchin expressions either improved or stayed for the face and body image compared to the face only image for all three expressions. The non-experienced participants mostly confused the distressed macaques as being 'happy' for both image types.

Table 15.

Confusion matrix to show what percentage of participants perceived each Capuchin's facial expression to be, split by expertise and country of residence.

Country	Image	Actual	Predicted (%)			
			Happy	Okay	Scared	Angry
UK Novice	Face	Neutral	2.4	**75**	20.8	1.8
		Distressed	**42.9**	16.7	26.8	13.7
		Aggressive	13.1	19.6	29.8	**37.5**
	Face + Body	Neutral	6.5	**73.2**	18.5	1.8
		Distressed	**32.1**	23.8	31.5	12.5
		Aggressive	2.4	10.7	17.3	**69.6**
Argentina Novice	Face	Neutral	0.9	**72.8**	24.6	1.8
		Distressed	**45.6**	11.4	29.8	13.2
		Aggressive	15.8	4.4	23.7	**56.1**
	Face + Body	Neutral	4.4	**74.6**	21.1	0
		Distressed	**49.1**	10.5	32.5	13.7
		Aggressive	7.9	4.4	20.2	**67.5**
Argentina Experienced	Face	Neutral	2	**80.4**	11.8	5.9
		Distressed	29.4	9.8	**37.3**	23.5
		Aggressive	3.9	2	31.4	**62.7**
	Face + Body	Neutral	7.8	**80.4**	7.8	3.9
		Distressed	15.7	5.9	**64.7**	13.7
		Aggressive	9.8	0	13.7	**76.5**

3.3.5. How perception of a capuchin will differ between a face only image and face and body image, and how participant experience with capuchins affects this.

A Wilcoxon signed-rank test was run between the unexperienced UK and Argentinian participants and the experienced Argentinian participants for average correct score between images (Figure 17).

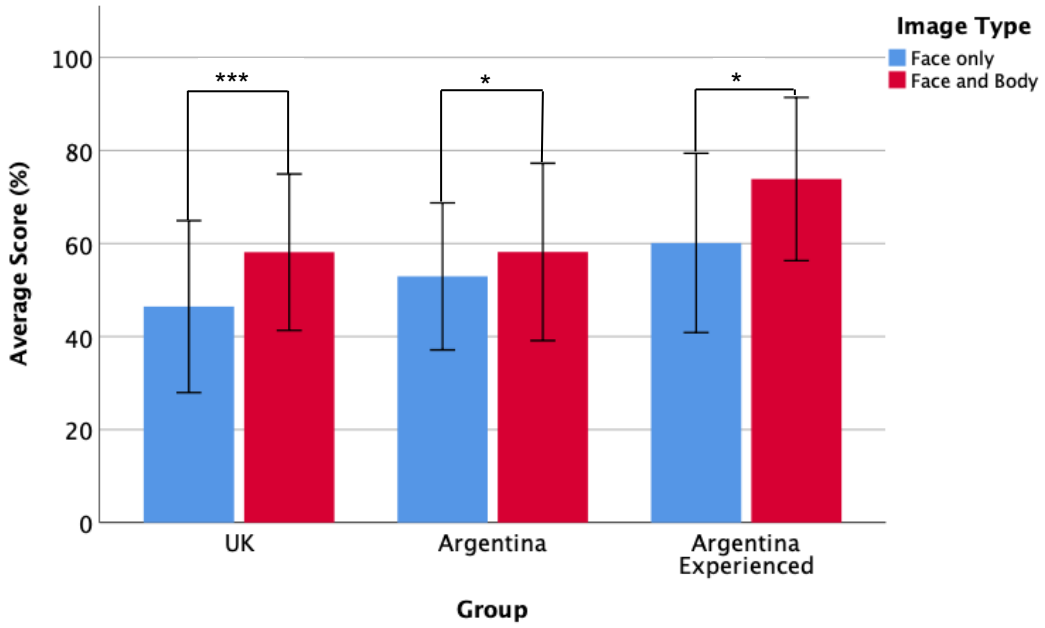
In UK participants, a Wilcoxon signed-rank test found a statistically significant difference between the average ability to accurately perceive face only and face and body images for capuchin facial expressions ($z = -4270$, $p < 0.001$). UK participants, on average, performed better for the face and body images compared to the face only images (Face only = 46.43 ± 18.48; Body = 58.14.19 ± 16.82).

In Argentinian participants with no experience, a statistically significant difference between the average ability to accurately perceive face only and face and body images for capuchin facial expressions ($z = -2.031$, $p = 0.042$) was found. Participants with no experience, on average, performed better for the face and body images compared to the face only images (Face only = 52.92 ± 15.81; Body = 58.19 ± 19.06).

In Argentinian participants with experience, a Wilcoxon signed-rank test found a statistically significant difference between the average ability to accurately perceive face only and face and body images for capuchin facial expressions ($z = -2.201$, $p = 0.028$). Participants with experience, on average, performed better for the face and body images compared to the face only images (Face only = 60.13 ± 19.27; Body = 73.86 ± 17.54).

Figure 17.

Mean correct score comparing face and body and face only images

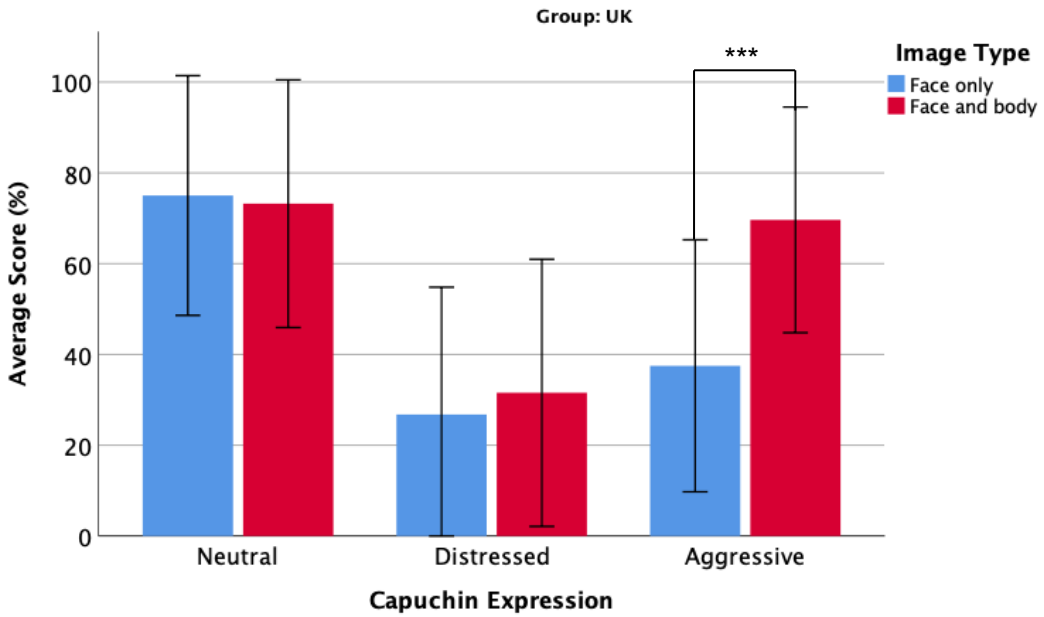


Note: The average participant score in percent for ability to accurately perceive capuchin facial expressions between face only and face and body images; in non-experienced UK and Argentinian participants, and experienced Argentinians (error bars 1 SD). * P<0.05, ** P<0.01, *** P<0.001.

In novice UK participants and for each individual expression, a Wilcoxon signed-rank test found a statistically significant difference for aggressive expressions ($z = -5.053$, $p < 0.001$), but not for neutral ($z = -0.623$, $p = 0.533$) or distressed ($z = -1.544$, $p = 0.122$) between the two image categories (Figure 18). UK participants performed better for the face and body aggressive images compared to the face only aggressive images (Face only = 37.50 ± 27.75; Body = 69.64 ± 24.84).

Figure 18.

UK mean correct score comparing face only and face and body images

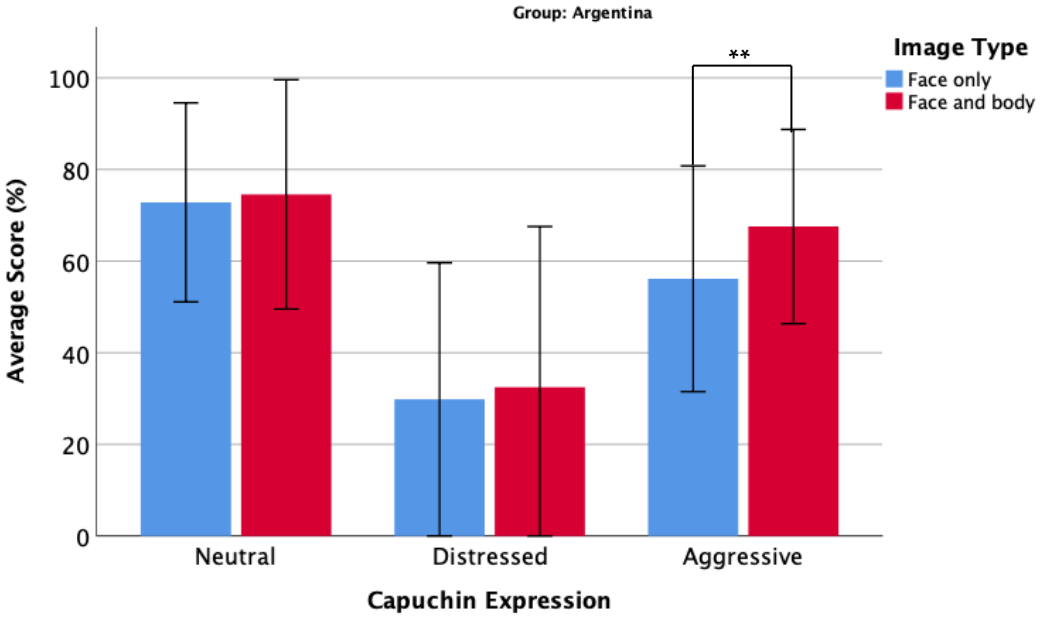


Note: The average participant score in percent for ability to accurately perceive neutral, distressed and aggressive capuchin facial expressions between face only and face and body images; in non-experienced UK participants (error bars 1 SD). * P<0.05, ** P<0.01, *** P<0.001.

In novice Argentinian participants and for each individual expression, a Wilcoxon signed-rank test found a statistically significant difference for aggressive expressions (z = -3.055, p = 0.002), but not for neutral (z = -0.090, p = 0.929) or distressed (z = -0.841, p = 0.400) between the two image categories (Figure 19). Novice Argentinian participants performed better for the face and body aggressive images compared to the face only aggressive images (Face only = 56.14 ± 24.64; Body = 67.54 ± 21.21).

Figure 19.

Argentina mean correct score comparing face only and face and body images

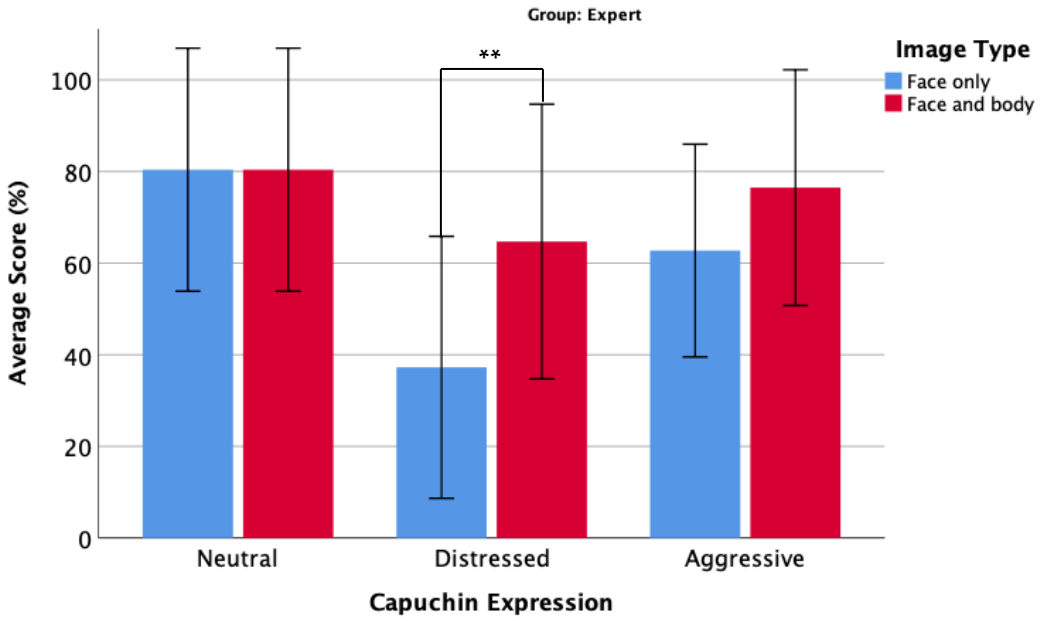


Note: The average participant score in percent for ability to accurately perceive neutral, distressed and aggressive capuchin facial expressions between face only and face and body images; in non-experienced Argentinian participants (error bars 1 SD). * P<0.05, ** P<0.01, *** P<0.001.

In experienced Argentinian participants and for each individual expression, a Wilcoxon signed-rank test found a statistically significant difference for distressed expressions (z = -2.809, *p* = 0.005), but not for neutral (z = -0.137, *p* = 0.891) or aggressive (z = -1.570, *p* = 0.116) between the two image categories (Figure 20). Experienced Argentinian participants performed better for the face and body distressed images compared to the face only distressed images (Face only = 37.25 ± 28.58; Body = 64.71 ± 29.98).

Figure 20.

Experienced Argentinian mean correct score comparing face only and face and body images



Note: The average participant score in percent for ability to accurately perceive neutral, distressed and aggressive capuchin facial expressions between face only and face and body images; in experienced Argentinian participants (error bars 1 SD). * P<0.05, ** P<0.01, *** P<0.001.

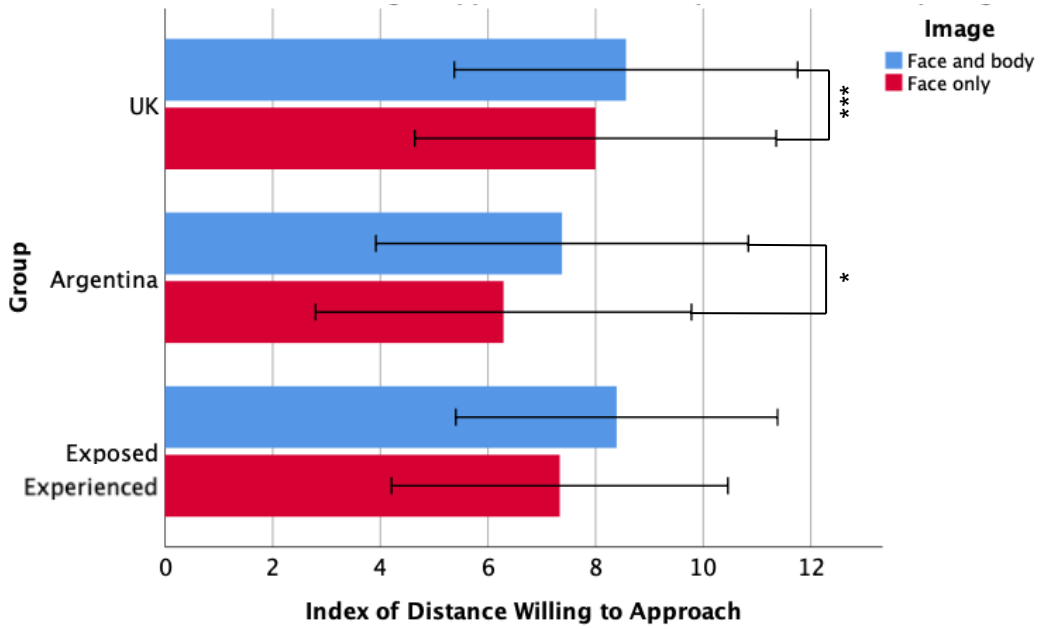
3.3.6 How behaviour towards a capuchin will differ between a face only image and face and body image, and how participant experience with capuchins affects this.

A Wilcoxon signed-rank test was run between the unexperienced UK and Argentinian participants and the experienced Argentinian participants to test for differences in their average distance willing to approach for face only and face and body capuchin images (Figure 21). In UK participants, a Wilcoxon signed-rank test found a statistically significant difference between the average distance willing to approach for face only and face and body images (z = -6.499, $p < 0.001$). UK participants, on average, approached from significantly further away for the face and body images compared to the face only images (Face only = 6.56 ± 2.16m; Body = 8.57 ± 2.81m). In unexperienced Argentinian participants, a Wilcoxon signed-rank test found a statistically significant difference between the distance willing to approach for face only and face and body images (z = -2.556, $p = 0.011$). Unexperienced Argentinian participants, on average, approached from significantly further away for the face and body images compared to the face only images (Face only = 6.76 ± 3.01m; Body = 7.17 ± 2.89m). In experienced Argentinian participants, a Wilcoxon signed-rank test found no statistically significant difference between the

distance willing to approach for face only and face and body images (z = -1.574, *p* = 0.115).

Figure 21.

Mean distance willing to approach for face only and face and body images



Note: The mean index of participant distance willing to approach the capuchin images in metres, from touching (0) to would not approach (11). Split by face only and face and body images; for non-experienced UK and Argentinians and experienced Argentinian participants (error bars 1 SD). * P<0.05, ** P<0.01, *** P<0.001.

A Wilcoxon signed-rank test was run between the unexperienced UK and Argentinian and experienced Argentinians to test for differences in distance willing to approach for face only and face and body capuchin images between each expression. For distressed expressions, a Wilcoxon signed-rank test found a statistically significant difference between the distance willing to approach for face only and face and body images in UK participants (Face only = 7.65 ± 3.54m, Body = 8.39 ± 3.15m; *p* = 0.004). For aggressive expressions, a Wilcoxon signed-rank test found a statistically significant difference between the distance willing to approach for face only and face and body images in every participant group (UK: Face only = 9.06 ± 2.72m, Body = 9.77 ± 2.39m; *p* < 0.001, Argentina novice: Face only = 6.29 ± 3.38m, Body = 9.15 ± 3.54m; *p* < 0.001, Argentina expert: Face only = 7.33 ± 3.02m, Body = 9.76 ± 2.05m; *p* < 0.001). For non-significant results see Table 16.

Table 16.

Wilcoxon signed ranks test for unexperienced UK and Argentinian and experienced Argentinians participants distance willing to approach capuchins based on their face only and face and body images per expression.

	UK		Argentina		Expert	
Face and Body vs Face only	*Z*	*P*	*Z*	*P*	*Z*	*P*
Neutral	-0.392	0.695	-0.343	0.731	-0.306	0.760
Distressed	-2.870	**0.004**	-1.859	0.063	-1.332	0.183
Aggressive	-3.600	**<0.001**	-4.861	**<0.001**	-4.861	**<0.001**

3.4. Discussion

This study explored the effects that different levels of exposure to capuchins has on how humans perceive capuchin facial expression and how this perception affects their behaviour towards capuchins. This study also aimed to identify any differences between face only and face and body images in human recognition and behaviour towards primate facial expressions. Novice Argentinians were more accurate in their perception of aggressive capuchin expressions compared to novice UK participants. Novice Argentinians also approached neutral and distressed capuchins closer than UK participants. Both novice and experienced participants were more accurate in their capuchin facial expression recognition when viewing the full face and body image compared to a face only image.

In regard to the Universality Hypothesis, this research suggests that a difference in natural exposure between two countries and taught experience influences human ability to accurately recognise primate facial expressions. For all of the expressions, accuracy percentages were found to increase from the least exposed UK novice, to Argentinian novice, to Argentinian experienced. However, for neutral capuchin expressions, all three groups scored consistently high ranging from 76% - 85% accuracy. This result is surprising due to neutral expressions being the most difficult for humans to decode (Durand et al., 2007). The high scores could be due to the similarities between a neutral capuchin expression and a neutral human

expression. Both mainly feature a closed straight mouth with an overall relaxed face. So instead of humans being able to infer primate expressions, they are most likely applying their knowledge of how to interpret human expressions onto primates, so are anthropomorphising the animal. This would also explain why high percentages of participants perceived distressed capuchins as happy, the wide teeth bearing grin signature of a distressed primate also resembles that of a happy human smiling (Preuschoft & Van Hoof, 1997; Maréchal et al., 2017). This misunderstanding of teeth displays is also shown in children perceiving aggressive dogs as happy and smiling (Meints et al., 2010, 2018). Therefore, our findings support evidence towards the expertise hypothesis, or a more shallow perception bias, rather than the Universality hypothesis.

Aim 1 – Perception of Facial expressions

The first aim of the study was to assess whether human accuracy of capuchin facial expression perception is determined by exposure via country of residence, gender or type of expression. No effect of country of residence or gender on the average participant ability to accurately perceive capuchin facial expressions was found. When comparing each expression individually, a statistically significant difference between novice UK and Argentinian participants for aggressive capuchin expressions was found, in that Argentinian participants were more accurate than UK participants. No differences between participants for neutral or distressed expressions were found. A further GLMM also found that country of residence, gender and age did not significantly predict participants ability to accurately recognise capuchin facial expressions. The only significant difference in the participants performance was dependent on the type of facial expression, with aggressive and distressed expressions being more difficult to accurately perceive than neutral expressions.

It was hypothesised that Argentinian citizens, even with no capuchin experience or training, would have superior facial expression recognition ability of the species compared to citizens of the UK. Especially since wild capuchins are native to Argentina, therefore Argentinians should have more natural exposure to them through the media and local wildlife parks. It may be possible that the nonsignificant average result is due to the Argentinian participants having less exposure to the capuchins than expected. For instance, it has been found that locals

of Gibraltar rarely visit the Upper Rock reserve where macaques are present, however, in Bali the locals often visit the temples where macaques are situated for religious ceremonies (Fuentes et al., 2007). So, depending on circumstances, some Argentinian citizens who live in cities may have had no exposure to capuchins at all. From our sample, 18 of the 38 had not reported ever encountering a live capuchin.

A significant difference was found for accurate recognition of aggressive capuchins between the two groups, with Argentinians being more accurate. A possible reason for this is Argentinian citizens having to be more aware of what an aggressive capuchin looks like, in-case they ever encounter one, or having more exposure to them in the media. There is also the potential for differences to exist in the type of expressions participants are exposed to, if at all, between a UK typical zoo environment and a wild environment as found in Argentina. Aggressive behaviours may be suppressed in a zoo environment as they are seen as undesirable. It has been suggested that temperament in captive mammals is shaped by directional selection and a preference for docility as aggressive animals are more difficult to handle, transport and medicate (Endler, 1986; McDougall, Réale, Sol & Reader, 2006). These selective pressures that captive zoo animals are exposed to alter the behavioural expression within a population and over generations results in a captive population that behaves differently to their wild counterparts (McPhee & Carlstead, 2010). Not only is aggressive behaviour discouraged, but in a captive environment there is typically no predation or threats for animals to respond to aggressively. As well as this, zoo visitors are less likely to closely interact with the animals to view their expressions for safety reasons, unlike in the more relaxed wild settings. These reasons potentially explain why aggressive expression would be less witnessed by UK citizens in zoos compared to the Argentinian citizens viewing capuchins in the wild.

As found in Maréchal et al. (2017), the type of facial expression influenced human perception ability. For Barbary macaques they found that participants were more accurate at perceiving neutral expressions followed by aggressive expressions, performing the worst for distressed and friendly expressions. In this study the same pattern with capuchins was found, participants performed the best for neutral expressions followed by aggressive then distressed. This is interesting as although there are differences in these two primate species facial displays, human ability to perceive them is similar.

Aim 2 – Behaviour towards Capuchins

The second aim of the study questioned whether exposure via country of residence, gender, age and type of expression will influence how close humans chose to: intended proximity to approach, feed or take a selfie with the Capuchins. It was found that males chose to approach the capuchins significantly closer than females, with no effect of country of residence. Also, that novice Argentinians approached neutral and distressed capuchins closer than UK participants, with no significant differences between participants for aggressive expressions. A strong, positive correlation between age and distance willing to approach was found, with younger participants choosing to approach the capuchins at closer distances.

It was originally hypothesised that, based on reported tourist and citizens behaviour, the UK participants would approach the capuchins closer than the Argentinian citizens, as they would be a more unfamiliar and novel stimuli (Fuentes et al., 2007). On the contrary to what was expected, novice Argentinian participants on average approached the capuchins 1.39m closer than UK participants chose to. Whilst this average difference was not significant, the difference between for neutral and distressed capuchins was. It is possible that because the capuchins are more familiar to the Argentinian participants, this may actually make them feel more comfortable with approaching them at closer distances. Whereas UK participants may be more unfamiliar with the size and mannerisms of a capuchin, so would be more hesitant to approach. This finding seems to reflect what is currently being observed in wildlife tourist areas of Argentina (Tiddi, personal communication).

For approach behaviour, both age and gender were found to be significant contributors, in that younger male participants approached the capuchins at closer distances. This is not the first instance of wildlife tourism research finding individual differences in approach behaviour. Stazaker and Mackinnon (2018) found that tourists who chose to have a photo with macaques were typically younger. This could be linked to risk-taking tendencies, as younger adults are found to be more prone to taking risks (Rolison, Hanoch, Wood & Liu, 2013). And within young adults, males in particular have been identified as high-level risk takers (Mohammadpoorasl, Ghahramanloo & Allahverdipour, 2013).

Aim 3 – Face only vs. Face and Body images

The third and final aim of the study was to investigate how perception of and behaviour towards a capuchin will differ between a face only image and face and body image, and how participant experience with capuchins affects this. In terms of perception, it was found that novice UK, Argentinian and experienced Argentinian participants all, on average, performed better for the face and body images compared to the face only images. Further tests found that both of the novice UK and Argentinian groups performed significantly better for the face and body aggressive images compared to the face only aggressive images. Whilst the experienced Argentinian participants performed significantly better for the face and body distressed images compared to the face only distressed images. For participant behaviour towards the capuchins, it was found that both of the novice UK and Argentinian groups, on average, approached from significantly further away for the face and body images compared to the face only images. In experienced Argentinian participants, there was no significant difference between the distance willing to approach for face only and face and body images. Both novice groups and the experienced Argentinians approached the face only aggressive capuchin significantly closer than the face and body aggressive capuchin. Whilst UK participants also approached the face only distressed capuchins closer than the face and body distressed capuchins.

For both perception of and behaviour towards the capuchins, the aggressive expressions displayed the most significant differences between the face only and face and body images. Similar has previously been found in humans, with research suggesting that because an expression of anger constitutes a direct threat, being able to recognise the emotion from a distance via the body would be more advantageous than getting close to an aggressive face (Martinez et al., 2015). It has also been found that angry body postures are more rapidly detected than happy body postures (Gilbert, Martin & Coulson, 2011). Therefore, it can be concluded that for emotion recognition, the body may not be necessary when it is not very expressive for instance in neutral expressions. But for distressed and especially aggressive expressions, body language in primates improves the accuracy of human emotion inference and is therefore important for interspecies communication. Because of this it could be argued future research into interspecies facial expression

recognition should be conscious to include bodily expressions, as well as the face, especially when aggressive expressions are involved.

Two significant findings that stood out when comparing the effects of experience in face only and face and body images. The first being that experienced participants perception accuracy significantly improved when viewing the body of the distressed capuchin and not for the aggressive, opposite to the novice participants. From this finding it can be established that when a level of experience with capuchins is reached, how their facial expressions are perceived changes. It is possible that the novice groups did not have sufficient enough knowledge to infer emotion from the distressed capuchin bodies, which is why their ability did not differ between the face and body images. Whereas the experienced participants needed the bodily expressions to help distinguish whether the capuchin was friendly or distressed, two expressions most frequently confused with each other. Similarly, with the aggressive expressions, the experienced participants may have had sufficient information from the face alone and the body did not have a significant amount of information to add. Whereas novice participants needed these additional cues from the body. The second significant finding is that the average distance willing to approach did not significantly differ between image type for the experienced participants, like it did for novice participants. This may be because the experienced participants were the most accurate and consistent with their emotion perception of the capuchins. If their perception of emotion did not change, neither would their distance willing to approach.

A limitation with the face and body aspect of this research comes with the stimuli, as we only had access to static images of capuchins in the wild. A common protocol with human research is to use dynamic stimuli, such as videos, as they are better recognised than static still images (Ambadar, Schooler & Cohn, 2005). However, unlike with humans, animals are hard to capture displaying certain expressions naturally, so such stimuli were not readily available. Therefore, using images that displayed clear movement and removing any interfering background was the most controlled way currently available. Future research in the area could potentially utilise videos of capuchins in their natural environment displaying these behaviours. This would also have the advantage of providing participants with useful vocal context as well (Van den Stock, Righart & de Gelder, 2007).

Conclusions

The findings from this research can be used to inform and improve wildlife tourism safety. For instance, it is current practice in some wildlife parks to signpost warning signs telling visitors to avoid the primates, with some success (Fuentes et al., 2007). However, it has also been established that tourists will still feed and interact with the monkeys when informed not to (Tiddi et al., 2019). Therefore, it may be beneficial to inform participants of warning signs of an aggressive or distressed monkey. It is practice in some wildlife parks (©Trentham Monkey Forest 2020) to signpost monkey facial expressions with meanings. However, with our research finding the importance of a whole-body image when perceiving aggressive and distressed capuchin facial expressions, a whole-body image should be included in such signs in wildlife parks. Pointing out the characteristic of a distressed and aggressive body may prove equally important, especially since participants approached capuchins from further away when viewing the full body image. These significant differences found between the face and body images for both human perception of and behaviour towards capuchins should also highlight the importance of using full body images in interspecies facial expression research. However, it is important to note that no differences were found for neutral expressions of either category, meaning research into human perception of primate facial characteristics (Clark et al., 2020) should still yield accurate data.

In summary, the present study has found that experience with and exposure to capuchins increases human ability to accurately perceive certain, if not all, capuchins facial expressions. The type of expression perceived was one of the main factors found to influence human perception of capuchin emotions, with neutral being the easiest for participants to perceive followed by aggressive and distressed expressions. This study has investigated both the Universality and Expertise hypotheses, concluding that whilst a basic ability to infer primate expressions can be achieved, expertise is necessary for advanced interspecies communication. This knowledge can be used to develop educational strategies for a safer wildlife tourism experience.

Chapter 4

4.2. General Discussion

The research found there to be no developmental effect present in human perception of macaque facial expressions, whilst there was an effect of greater exposure to capuchins improving expression perception ability. The type of expression perceived significantly impacting participant perception ability and approach behaviour towards the Barbary macaques and capuchins.

Study 1 explored the developmental progression of how humans perceive human and Barbary macaque facial expressions and how this perception impacts their behaviour towards Barbary macaques. Humans were not very good at accurately perceiving Barbary macaque facial expressions, and this ability did not improve with age as found with human facial expressions, but only improves depending on the type of expression. Participants were more able to accurately perceive neutral, friendly and very aggressive facial expressions than aggressive and distressed expressions. Younger participants approached significantly closer to the macaques, with boys most often approaching aggressive macaques. Study 2 explored the effect that different levels of exposure to capuchin monkeys has on human ability to perceive capuchin facial expression and behave towards them. It was found that novice Argentinians were more accurate in their perception of aggressive capuchin expressions compared to novice UK participants. For all of the expressions, accuracy percentages were found to increase from the least exposed UK novice, to Argentinian novice, to Argentinian experienced. Novice Argentinians approached neutral and distressed capuchins closer than UK participants. Both naïve and exposed participants were more accurate in their capuchin facial expression recognition when viewing the full face and body image compared to a face only image.

In terms of perception, for both capuchins and macaques, neutral expressions had the highest accuracy percentages in adults. The neutral expressions may be easier for the adults to perceive due to the lack of expression potentially being easier to categorise than an unfamiliar or unknown expression. Children, however, performed poorly for the neutral macaques, more so perceiving them as angry. Distressed monkeys were commonly difficult for humans to recognise in both species, frequently being confused as ‘happy’. This finding has previously been

found in dog expression research (Meints et al., 2010, 2018). This is a very concerning finding for safety reasons; for instance, it was found that when participants perceived a monkey to be friendly, they approached it at closer distances when compared to the other expressions, and a distressed animal can soon become aggressive if provoked by approach.

When looking at human approach distance, it was established that the type of facial expression perceived does significantly affect approach behaviour, albeit in a few different ways. In general, humans anthropomorphised the monkeys when asked to attribute an emotional state to them, in order to be able to infer how to behave. In the first study, it was found that participants' approach behaviour differed when comparing what they perceived the macaques' expression to be, compared to what it actually was. For instance, participants chose to leave more distance between themselves and the macaques they perceived to be scared than the distressed macaques. In the second study, when participants viewed the full body capuchin images, participants became more accurate in their expression perception and consequently approached less. Both of the studies also found a general link that younger males approach the monkeys at closer distances, therefore presenting as a target demographic for intervention.

Thus, from both studies it can be concluded that the amount of experience that a human has with a specific species influences their ability to perceive that species' facial expressions. For humans to improve their ability to perceive Barbary macaque and capuchin facial expressions, they need more experience with Barbary macaques and capuchins. The role of experience in facial expression between different species perception needs to be researched further.

One of the only distinct differences between the two studies findings were that when comparing the adult participants only, study 1 found in the practical task that participants approached the friendly and distressed macaque the closest, followed by the aggressive then neutral and very aggressive. In contrast, in study two both the UK and Argentinian participants approached the neutral capuchins the closest followed by distressed then aggressive capuchins. It is hard to compare these two findings directly due to the difference in participants, species and images used, as it is possible that any one of these factors is the cause behind the differing finding. For instance, Argentinians may be more drawn to a neutral face, perceiving It as less threatening. Or it could be that a capuchin neutral face is less threatening than a

macaque neutral face.

In each study an additional measure was included, as a way of expanding animal facial expression research methodologies. Namely a practical task with monkey cut-outs and an accurate, to-scale distance measure as well as comparing the effect of a full body image and a face only image. The study results showed that the most accurate way to measure human perception of and behaviour towards primates is a questionnaire or practical task with a full body image. Future research could go even further to include vocalisations, mouth movements and body movements (Partan & Marler, 2005), using videos of monkey behaviour and projecting this for participants at a realistic scale, however, still in a controlled lab setting.

One of the main challenges in this study lay in physical space restriction – it was only possible to use a distance of 5m when 10m would have been ideal. The study set up itself was somewhat time-consuming and required more than one person. The lab setting itself also lacks some ecological validity as participants know they are in a safe environment. While this may not yield truly accurate results, however, it can still be reflective of real-world findings.

The set distance limits may have also influenced participant behaviour. In study 1 the limit was 5m due to the aforementioned space issue, in study 2 this was the ideal 10m limit. When comparing the two sets of UK adults' (aged 22+) questionnaire responses (not including those who chose not to approach), the average approach distance in Study 1 was 3.24m whilst Study 2, with the greater range, had an average approach distance of 5.13m. Even though these are two different sets of participants, it represents a potential influence that a limiting factor can cause and is something that future research should take into account.

A final general difficulty the study faced was stimuli accessibility, finding capuchin images with enough of their body showing for study 2 was a challenge, to the extent that a 'friendly' expression category could not be included. There are also general issues with displaying non-human animal facial expressions via images, such as intensity variations and blended signals causing conflicting motivations which should also be taken into consideration with this research (Waller & Micheletta, 2013; Parr et al., 2005).

In sum, humans' ability to accurately perceive primate facial expressions does not develop by itself with age, but with taught meaningful exposure to the species

and is dependent on the type of expression.

Our findings can now be utilised to improve the overall safety of wildlife tourism as they highlight the need for physical distance markers in place in wildlife parks, as well as illustrative images instead of text as images would be easier for children to understand. More education especially in young males is needed to avoid potential monkey bites in human-animal tourist interactions.

Interestingly, even though Argentinians had greater exposure and ability to perceive the expressions, they still approached at closer distances, so it is key that education and exposure are used together.

It can also be recommended that it would be beneficial for future primate research to gather high quality, dynamic stimuli, better representative of the animal expressions, and present these to participants in innovative ways that mimic real life wildlife tourism. A future study recommendation to combine both the experience and developmental aspect of this research would be to test children who have been exposed to monkeys' faces as this will provide new important information about the expertise effect from a developmental perspective.

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Appendix A1. Proof of Ethical Approval

Psychology Ethics Form

Tick relevant boxes: ☐ **STAFF Project** ☑ **POSTGRADUATE Project** ☑ **TRACK A**
☑ **UNDERGRADUATE Project** ☐ **TRACK B**
☐ **ROUTINE EXTENSION TO STUDY**

Title of Project: Human perception of primate facial expressions

Name of researcher(s): Laura Clark, Ella Bevington, Noah Simmons, Niamh Startin, Lucy Dunkerley, Jessica Legan, Jessica Silk, Leah Stephenson, Erin Selwood, Frances Cragg, Lucy Greenwood, Frances Barrow, Hannah Prest, Nadia Walters, Abigail Lewis, Faith Jones, Liam Pearson
Name of supervisor (for student research): Laetitia Marechal

Date: 14/10/19

		YES	NO	N/A
1	Will you describe the main procedures to participants in advance, so that they are informed in advance about what to expect?	✓		
2	Will you tell participants that their participation is voluntary?	✓		
3	Will you obtain written consent for participation?	✓		
4	If the research is observational, will you ask participants for their consent to being observed / taped?	✓		
5	Will you tell participants that they may withdraw themselves or their data from the research, that no reason needs to be given, and that they can do so without losing any rewards **(if applicable)?**	✓		
6	Will you give participants the option of declining to give information they do not want to give (e.g., not filling out all questions in a questionnaire)?	✓		
7	Will you tell participants that their data will be treated with full confidentiality, and stored securely (for 5 years at the minimum) and that, if published, it will not be identifiable as theirs?	✓		
8	Will you debrief participants at the end of their participation (i.e. give them a brief explanation of the study)?	✓		

If you have ticked **No** to any of Q1-8, but have **ticked box A** overleaf, please give any explanation on a separate sheet. (Note: N/A = not applicable)

		YES	NO	N/A
9	Will your project involve deliberately misleading participants in any way?		✓	
10	Is there a realistic risk of any participants experiencing either physical or psychological distress or discomfort? If **Yes,** give details on a separate sheet and state what you will tell them to do if they should		✓	

	experience any problems (e.g. who they can contact for help).				

If you have ticked **Yes** to 9 or 10 you should normally **tick box B** overleaf; if not, please give a full explanation on a separate sheet.

			YES	NO	N/A
11	Do participants fall into any of the following special groups? If they do, please refer to the appropriate BPS guidelines, and **tick box B** overleaf. **Please note that you may also need to gain satisfactory CRB clearance or equivalent for overseas participants.**	School children (under 16 years of age)		✓	
		People with learning or communication difficulties		✓	
		Patients		✓	
		Those at risk of psychological distress or otherwise vulnerable		✓	
		People in custody		✓	
		People engaged in illegal activities (e.g. drug taking)		✓	

There is an obligation on the lead researcher to bring to the attention of the School's Ethics Committee projects with ethical implications not clearly covered by the above checklist.

Please tick either box A or box B below and provide the details required in support of your application, then sign the form.

Please tick:

A. I consider that this project has no significant ethical implications to be brought before the Departmental Ethics Committee.	✓

In less than 150 words, provide details of the study including the rational, the number and type of participants, methods and tests to be used (i.e. the procedure).

This study aims to investigate human ability in perceiving non-human primate facial expressions and if their perception influences their behaviour towards the animal. From this we can form educational strategies for safer wildlife tourism. We aim to recruit 25 participants aged between 18-21 who are students at the University of Lincoln. The participants will be asked to complete two tasks. One of the tasks is a Qualtrics questionnaire, participants will be shown pictures of monkeys and humans with varying facial expressions. They will then be asked how they think the person/monkey are feeling and how close they would like to get to approach, feed and to take a selfie with them. The other task is a practical task with life size cardboard monkey stimuli, where the participants will be asked again how close they would like to approach each of the monkeys and how they think they are feeling.

This form (and any attachments) should be submitted to the school's Ethics Committee where it will be considered by the Chair before it can be approved.

B. I consider that this project may have ethical implications that should be brought before the Departmental Ethics Committee, and /or it will be carried out with children or other vulnerable populations.	

Please provide details of the project on an *EA2 University Ethics for Human Participants*, taking into account the following advice:

1. Be clear about the purpose of the project and its academic rationale.
2. Briefly describe the methods / measurements and parties involved / affected.
3. Be clear about recruitment methods, numbers used, age, gender, exclusion/inclusion criteria, handling procedures for field experiments, etc.
4. Include concise statements of the ethical considerations raised by the project (including care and aftercare) and how you intend to deal with them.
5. Include all relevant materials, such as consent form, participant information form, debrief,

questionnaire / stimulus materials, letters/posters to recruit, etc. *This form should be submitted to the School's Ethics Committee for consideration.* *If any of the above information is missing, your application will be returned to you.*

I am familiar with the BPS Guidelines for ethical practices in psychological research, and the University Regulations for Ethical Research (and have discussed them with other researchers involved in the project or my supervisor)

Signed: lclark Print Name: Laura Clark
Date: 14/10/19
(UG/PG Researcher(s), if applicable) Email: laclark@lincoln.ac.uk

Signed: Print Name:
Date:
(Lead Researcher or Supervisor) Email:

Statement of Ethical Approval

This project has been considered using agreed Departmental procedures and is now approved.

UNIVERSITY OF LINCOLN

Application Details

Ethics Reference	2019-0854
Title of Project	Human perception of primate facial expressions
Lead Researcher	Laura Clark
Academic Supervisor	Kerstin Meints, Laetitia Marechal
Committee	Human Ethics Committee
Date of Ethical Opinion	5 December 2019

Favourable Opinion

Thank you for your revised submission. The further information has been considered, on behalf of the committee and I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form and supporting documentation.

The favourable ethical opinion provided is conditional to the following requirements:

- Personal data should be destroyed when it is no longer necessary to contact participants.
- The following must be added to any recruitment materials (including posters, adverts, social media posts
  - The project [insert study title] contributes to research conducted on behalf of the University of Lincoln and has received a favourable ethical opinion by a University Research Ethics Committee (Insert Ethics Reference - given at the top of this letter) in accordance with the Guidelines for research recruitment materials (available on the ethics portal page).

- Please ensure that a version number and date is included on all recruitment materials (this should be the same as the version number and date listed on your favourable opinion letter).

1. Commencement of the research

1.1 Risk Assessment: In accordance with H&S policy and guidance, a risk assessment must be completed or existing risk assessment reviewed/updated before data collection commences. A copy of the risk assessment should be retained with your research data.

1.2 It is assumed that the research will commence within 12 months of the date of the favourable ethical opinion.

1.3 If the research does not commence within 12 months of the favourable opinion being issued, the lead applicant (and academic supervisor for student research) should send a written explanation for the delay. A further written explanation should be sent after 24 months if the research has still not commenced.

1.4 If the research does not commence within 24 months, the REC may review its opinion.

2. Duration of favourable opinion

2.1 The favourable ethical opinion of the REC for a specific research study applies for the duration of the study, as detailed in your application (or any subsequent amendments).

3. Amendments

3.1 If it is proposed to make an amendment to the research, the lead applicant (authorised by the academic supervisor for student research) should submit an amendment to the REC by accessing the original application form on LEAS and creating an amendment form.

4. Monitoring

4.1 Research Ethics Committees may review a favourable opinion in the light of progress reports and any developments relevant to the study. The lead applicant and academic supervisor (for student research), is responsible for ensuring the research remains scientifically sound, safe, ethical, legal and feasible throughout its duration. The lead applicant and academic supervisor (for student research) should submit a progress report to the REC 13 months after the date on which the favourable opinion was given. Annual progress reports should be submitted thereafter.

4.2 Progress reports should be completed and submitted using the forms in LEAS.

5. Conclusion or early termination of the research

5.1 The Lead Applicant should complete the End of Study Form in LEAS once the study has completed. It is also their responsibility to inform the Committee of early termination of the project or if the work is not completed.

6. Long Term Studies

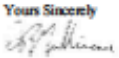
6.1 The lead applicant and academic supervisor (for student research) is responsible for ensuring that the study procedures and documentation are updated in light of legislative or policy changes and also for reasons of good practice (e.g. standards for supporting documentation). This should be documented in the progress report to the REC (see above) and, where necessary, an amendment (see above) should be submitted to the REC. The REC may review its opinion in light of legislative changes or other relevant developments.

Additional guidance may be found at here

Statement of Compliance

The Committee is constituted in accordance with the University of Lincoln Research Ethics policy and E-QMS SOP E-01 Ethics Committee Operations.

Yours Sincerely



Professor David Mullineaux

On behalf of Human Ethics Committee

Approved list of documents (if applicable):

Document Type	File Name	Date	Version
Questionnaire questions	Human perception of primate facial expressions, 01:10:2019, Questionnaires	01/10/2019	1
Stimuli	Human perception of primate facial expressions, version 1, 01:10:19, Stimuli	01/10/2019	1
Other documents	Human perception of primate facial expressions, 15:10:19, Summary Document of changes made following Governance	15/10/2019	1
Other documents	Human perception of primate facial expressions, Version 1.0, 21:11:19, School Info Sheet	21/11/2019	1
Advertisement materials for participants	Human perception of primate facial expressions, Version 2.0 01:10:2019, Recruitment	21/11/2019	2
Participant Information Sheet	Human perception of primate facial expressions, Version 2.0, 21:11:19, Info Sheet	21/11/2019	2
Consent Form	Human perception of primate facial expressions, Version 2.0, 21:11:19, Adult consent form	21/11/2019	2
Participant Information Sheet	Human perception of primate facial expressions, Version 2.0, 21:11:19, Parental Info Sheet	21/11/2019	2
Consent Form	Human perception of primate facial expressions,Version 2.0, 21:11:19, Parent consent form	21/11/2019	2
Debrief Sheet	Human perception of primate facial expressions, version 2, 21:11:19, Debrief	21/11/2019	2
Other documents	Human perception of primate facial expressions, 21:10:19, Head of school letter	21/11/2019	1
Other documents	Human perception of primate facial expressions, 21.10.19, Summer Scientist Ethics application 25072019	21/11/2019	1
Consent Form	Human perception of primate facial expressions, 21:10:19, Parent consent letter schools	21/11/2019	1
Participant Information Sheet	Human perception of primate facial expressions, version 2, 21:11:19, 6-11 info sheet	21/11/2019	2
Participant Information Sheet	Human perception of primate facial expressions, version 2, 21:11:19, Under 5 Info	21/11/2019	2
Other documents	Human perception of primate facial expressions, 3:12:19, Ethics reviewer comments and responses	03/12/2019	2

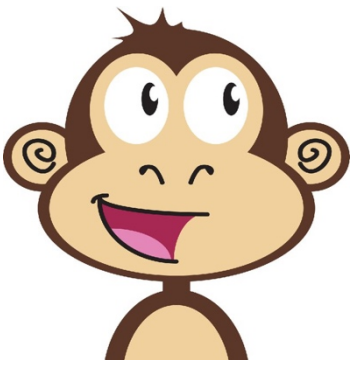
UNIVERSITY OF LINCOLN

Child Perception of Primate Facial Expressions

Age 5 and under - Information Sheet

Hello, I am Laura.
Laura is a researcher. Researchers find the answers to questions.

Today's question is:
What mood is this monkey



Would you like to help Laura find out the answer?

To help Laura you will have to tell us how you think the monkeys are feeling.

If you don't want to take part anymore you can tell your parents or one of our helpers.

6-11 year old Information Sheet

What mood is this monkey?

Researcher: Laura

What is research?

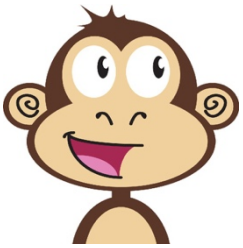
Research is a way of finding out answers to questions when we don't know enough.

Why are we doing this research?

We know that many children develop in different ways. We would like to learn more about this by getting children like you to take part in our monkey game today.

Why me?

We are inviting you to take part because you are just the right age and we think you would find the activities fun!



- We need children aged 5, 7 or 9 years old who would like to look at pictures of monkeys.

Did anyone test the study is ok to do?

Before any research is allowed to go ahead, it has to be checked by a group of people to make sure that the research is fair.

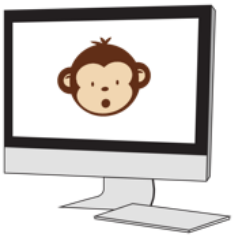
Do I have to take part?

No! You don't have to take part if you don't want to. Please read this sheet and talk to your Mum, Dad or Carer before you decide. If you don't want to take part, just say no.
You can stop whenever you want, and you don't have to say why. Just tell the researcher or your adult.

What will happen if I take part?

1. We will ask you and your Mum, Dad or Carer to write your names on a form to say you'd like to take part.

2. There is a computer game where we will show you pictures of monkeys and people and ask you how you think they are feeling.



3. Then there is the monkey game! Where we will have some cardboard monkeys to show you and to ask you some questions about.

How long will it ta
This study will
minutes.

Will anything about this research upset me?

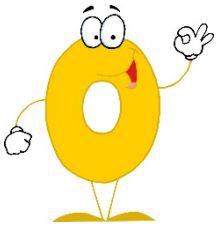
We do not think anything in this research will upset you, but if you are upset you can tell one of the researchers or your Mum, Dad or Carer.

Will taking part help me?

The study will not help you right now. But it will help scientists understand how children like you develop.

Will anyone else know I'm doing the research?

The people in our research team will know you're taking part. Nobody else will know because we'll give you a number for the study instead of using your name.



What happens to what the researchers find out?

We will put the information in a long piece of writing that university students do called a thesis. We will also write a summary of the results for you to read if you would like.

How can I find out more about the study?

Your Mum, Dad or Carer may be able to answer your questions for you. You can also ask the researcher to answer your questions.

Parental Information Sheet/Information about the research
(Draft version 1 / Final version 2.0: 21/11/2019)

UNIVERSITY OF LINCOLN

Title of Study: Human perception of primate facial expressions
Name of Researchers: Laura Clark, Laetitia Marechal, Kerstin Meints
Contact Details of the Researchers are given at the end.

We'd like to invite you and your child to take part in our research study. Joining the study is entirely up to you. Before you decide, we would like you to understand why the research is being done and what it would involve for you. One of our team will go through this information sheet with you, to help you decide whether or not you would like to take part and answer any questions you may have. We'd suggest this should take about 5 minutes. Please feel free to talk to others about the study if you wish.

What is the purpose of the study?

Both humans and monkeys communicate their emotions through facial expressions. Depending on how they are recognised, these facial expressions can influence how people will act. In this study, we will see whether children and adults can tell the mood of these monkeys from pictures, and from this whether they would approach them or not. From this study we aim to assess whether there is a difference in how adults and children perceive monkey facial expressions and if these facial expressions also influence how we act around the animal. With this knowledge we aim to form strategies for safer wildlife tourism for all ages. The study will be conducted at the university in the Sarah Swift building.

Why have I been invited?

You and your child are being invited to take part because you have either in a previous study agreed to be contacted to take part in future research, signed up using the university's SONA system, or volunteered via our adverts.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part, you are still free to withdraw at any time and without giving a reason. This would not affect your legal rights.

What will happen to me if I take part?

If you and your child agree to take part, you will both have two tasks to complete which should take roughly 25 minutes in total. The computer task will involve you looking at pictures of monkeys and humans and answering some questions about them. There is also a practical task where we will ask you questions about five life-size cardboard monkeys. For both tasks the questions will be centred around how you think the monkeys are feeling and if you would like to approach them. We will only ask for your age and gender, and your results will be anonymised with a participant ID code. Parents/carers will also be asked to complete a questionnaire about their child's behaviour towards animals. This questionnaire includes some questions you may find of a sensitive nature surrounding animal cruelty. We ask that you answer these questions to your best knowledge but would like to remind you that your response to these questions is optional, and that refraining from answering will not impact your participation in this study.

Expenses and payments

You will not be paid to participate in the study, you and your child's participation is voluntary.

What are the possible disadvantages and risks of taking part?

If you or your child have any animal specific phobias the images used in this study may cause you distress and we recommend you not to take part if that is the case.

What are the possible benefits of taking part?

There will be no direct benefits from taking part in this study, but hopefully the knowledge that you are helping us to conduct research that should lead to safer wildlife tourism in the future will benefit you.

Will my taking part in the study be kept confidential?

We will follow ethical and legal practice and all information about you and your child will be handled in confidence. No names will be kept or used for data analysis, and participant ID codes will be used instead.

Privacy notice

The University of Lincoln is the lead organisation for this study and will be the data controller for this study. This means that we are responsible for looking after your information and using it properly. The university's Research Participant Privacy Notice https://ethics.lincoln.ac.uk/research-privacy-notice/ will explain how we will be using information from you in order to undertake this study.

What will happen if I don't want to carry on with the study?

You and your child's participation is voluntary, and you both are free to withdraw at any time, without giving any reason, and without your legal rights being affected. If you withdraw from the study, we will securely destroy any data collected from you. Please note that we will not be able to remove data once analysis has begun, we will however remove any identifiable data.

Where will my data be stored?

The data obtained from the study will be stored securely on the university OneDrive in a password protected file. Only the researchers will have access to it. The data from this study *may* be put in an Open Access repository. If so, any personal data (e.g. contact details) will be removed.

What will happen to the results of the research study?

This study is apart of an educational qualification and the results will be written up for the researcher's thesis as a part of their master's degree. Data will be treated confidentially and any publication resulting from this study will report only data that does not identify individual participants. Participants' anonymised responses, however, may be shared with other researchers or made available in online data repositories.

Who is organising and funding the research?

This research is being organised by the University of Lincoln.

Who has reviewed the study?

All research conducted by the University of Lincoln is looked at by an independent group of people, called a Research Ethics Committee, to protect your interests.

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to the researchers, who will do their best to answer your questions. The researchers' contact details are given at the end of this information sheet. If you remain unhappy and wish to complain formally, you can do this by contacting ethics@lincoln.ac.uk.

If you feel that we have let you down in relation to your information rights then please contact the Information Compliance team by email on compliance@lincoln.ac.uk or by post at Information Compliance, Secretariat, University of Lincoln, Brayford Pool, Lincoln, LN6 7TS.
You can also make complaints directly to the Information Commissioner's Office (ICO). The ICO is the independent authority upholding information rights for the UK. Their website is ico.org.uk and their telephone helpline number is 0303 123 1113.

Further information and contact details

Laura Clark at laclark@lincoln.ac.uk
Supervisors:
Dr. Laetitia Marechal at LMarechal@lincoln.ac.uk
Prof. Kerstin Meints at KMeints@lincoln.ac.uk

Title of Study: Human perception of primate facial expressions
Name of Researchers: Laura Clark
Contact Details of the Researchers are given at the end.

We'd like to invite you to take part in our research study. Joining the study is entirely up to you. Before you decide, we would like you to understand why the research is being done and what it would involve for you. One of our team will go through this information sheet with you, to help you decide whether or not you would like to take part and answer any questions you may have. We'd suggest this should take about 20 minutes. Please feel free to talk to others about the study if you wish.

What is the purpose of the study?

Both humans and monkeys communicate their emotions through facial expressions. Depending on how they are recognised, these facial expressions can influence how people will act. In this study, we will see whether people can tell the mood of these monkeys from pictures, and from this whether they would approach them or not. From this study we aim to assess how people perceive monkey facial expressions and if these facial expressions also influence how we act around the animal. With this knowledge we aim to form strategies for safer wildlife tourism for all. The study will be conducted at the university in the Sarah Swift building.

Why have I been invited?

You are being invited to take part because you are a student at the University of Lincoln and have volunteered, we are inviting 25 participants like you to take part.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part, you are still free to withdraw at any time and without giving a reason. This would not affect your legal rights.

What will happen to me if I take part?

If you agree to take part, you will have two tasks to complete which should take roughly 20 minutes in total. The computer task will involve you looking at pictures of monkeys and humans and answering some questions about them. There is also a practical task where we will ask you questions about five life-size cardboard monkeys. For both tasks the questions will be centred around how you think the monkeys are feeling and if you would like to approach them. We will ask for no sensitive information, only for your age and gender, and your results will be anonymised with a participant ID code.

Expenses and payments

You will not be paid to participate in the study, your participation is voluntary.

What are the possible disadvantages and risks of taking part?

If you have any animal specific phobias the images used in this study may cause you distress and we recommend you not to take part if that is the case.

What are the possible benefits of taking part?

There will be no direct benefits from taking part in this study, but hopefully the knowledge that you are helping us to conduct research that should lead to safer wildlife tourism in the future will benefit you.

Will my taking part in the study be kept confidential?

We will follow ethical and legal practice and all information about you will be handled in confidence. No names will be kept or used for data analysis, and participant ID codes will be used instead.

Privacy notice

The University of Lincoln is the lead organisation for this study and will be the data controller for this study. This means that we are responsible for looking after your information and using it properly. The university's Research Participant Privacy Notice https://ethics.lincoln.ac.uk/research-privacy-notice/ will explain how we will be using information from you in order to undertake this study.

What will happen if I don't want to carry on with the study?

Your participation is voluntary, and you are free to withdraw at any time, without giving any reason, and without your legal rights being affected. As your participation is anonymous it will not be possible to withdraw your data once submitted, as I/we have no way of identifying you.

Where will my data be stored?

The data obtained from the study will be stored securely on the university OneDrive in a password protected file. Only the researchers will have access to it. The data from this study *may* be put in an Open Access repository. If so, any personal data (e.g. contact details) will be removed.

What will happen to the results of the research study?

This study is apart of an educational qualification and the results will be written up for the researcher's RSIII research reports and as part of a separate thesis. Data will be treated confidentially and any publication resulting from this study will report only data that does not identify individual participants. Participants' anonymised responses, however, may be shared with other researchers or made available in online data repositories.

Who is organising and funding the research?

This research is being organised by the University of Lincoln.

Who has reviewed the study?

All research conducted by the University of Lincoln is looked at by an independent group of people, called a Research Ethics Committee, to protect your interests.

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to the researchers, who will do their best to answer your questions. The researchers' contact details are given at the end of this information sheet. If you remain unhappy and wish to complain formally, you can do this by contacting ethics@lincoln.ac.uk.

If you feel that we have let you down in relation to your information rights then please contact the Information Compliance team by email on compliance@lincoln.ac.uk or by post at Information Compliance, Secretariat, University of Lincoln, Brayford Pool, Lincoln, LN6 7TS.

You can also make complaints directly to the Information Commissioner's Office (ICO). The ICO is the independent authority upholding information rights for the UK. Their website is ico.org.uk and their telephone helpline number is 0303 123 1113.

Further information and contact details

Researchers:

RSIII Group details:

Laura Clark at laclark@lincoln.ac.uk

Supervisor:

Dr. Laetitia Marechal at LMarechal@lincoln.ac.uk

Appendix C1. Consent form

Project ID: 2019-0854

Participant Identification Number for this study:

UNIVERSITY OF LINCOLN

CONSENT TO PARTICIPATE IN RESEARCH

Title of Project: Human perception of primate facial expressions

Name of Researcher: Laura Clark

Name of Participant:

Please initial box

1. I confirm that I have read the information sheet dated 21/11/2019 (version 2) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my/ my childs participation is voluntary and that I am/ my childs free to withdraw at any time without giving any reason, without my legal rights being affected. I understand that should I/ my child withdraw then the information collected so far may not be erased and that this information may still be used in the project analysis. ☐

3. I understand that individuals may look at research data collected during the study, from the University of Lincoln, where it is relevant to my/ my childs taking part in this research. I give permission for these individuals to have access to my records; I understand that my/ my childs personal details shall be kept confidential. ☐

4. I understand that the information collected about me/ my child will be used to support other research in the future, and may be shared anonymously with other researchers. ☐

5. I agree to take part in the above study. ☐

6. I agree for my child to take part in the above study ☐

Name of Participant (Parent)	Date	Signature
Name of Participant (Child)	Date	Signature
Name of Person taking consent	Date	Signature

Project ID: PSY192039

Participant Identification Number for this study:

CONSENT TO PARTICIPATE IN RESEARCH

Title of Project: Human perception of primate facial expressions

Name of Researcher: Laura Clark

Name of Participant:

Please initial box

7. I confirm that I have read the information sheet dated 14/10/19 (version 2.0) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

8. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected. I understand that should I withdraw then the information collected so far may not be erased and that this information may still be used in the project analysis. ☐

9. I understand that individuals may look at research data collected during the study, from the University of Lincoln, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records; I understand that my personal details shall be kept confidential. ☐

10. I understand that the information collected about me will be used to support other research in the future, and may be shared anonymously with other researchers. ☐

11. I would like to receive a summary of the results of the study Yes ☐ N ☐

12. I agree to take part in the above study. ☐

Name of Participant	Date	Signature
Name of Person taking consent	Date	Signature

Appendix D1. Debrief

Participant Debrief Sheet

UNIVERSITY OF LINCOLN

(Final version 2.0: 21/11/19)
Title of Study: Human perception of monkey facial expressions
Name of Researchers: Laura Clark, Laetitia Marechal and Kerstin Meints
Contact Details of the Researchers are given at the end.

We'd like to thank you for your participation in our research study. This research will provide crucial information and broaden our understanding of interspecies communication and child development.

What was the aim of the study?
We have previously found out that people often misunderstand monkey facial expressions. For example, people have mistaken an aggressive face with a friendly face. We now want to learn how children interpret different monkey facial expressions. We also want to compare this to adults' interpretations. This will allow us to develop education tools to teach children and adults about monkeys' facial signals and how to interpret them correctly. As according to the World Health Organisation monkey bites are the second most common animal bite risk to travellers, developing a safety tool will hopefully keep children and adults safer in wildlife tourism.

As you saw images of monkeys (Barbary Macaques), we must emphasise the importance of safety with wild animals. Please do not approach any monkey, especially within 5 metres, for any activity such as to take photos of yourself. Please never feed any monkey under any circumstance.

Questions and withdrawing
If you have any further questions about the study, please feel free to ask the researcher before you finish or alternatively contact the researcher or their supervisor at any time on laclark@lincoln.ac.uk.

If you wish to withdraw your data, please also contact the researcher or supervisor on the details provided below.

Further help and support
If you have any ethical concerns regarding the current research, your treatment as a participant or your involvement in the study please feel free to contact ethics@lincoln.ac.uk. If you are concerned about your child's behaviour towards animals, further information can be found here https://www.nhs.uk/news/pregnancy-and-child/new-guidelines-on-child-antisocial-behaviour/

Contact Details of Researchers
Researcher: Laura Clark at laclark@lincoln.ac.uk
Supervisors:
Laetitia Marechal at lmarechal@lincoln.ac.uk
Kerstin Meints at Kmeints@lincoln.ac.uk

Child Debrief
– Dos and don'ts

- Thank you for playing today!

- Did you enjoy it?
- What did you learn today?

We just want to make sure you learned the right thing today:

Do you understand what to do?

- Always stay at a safe distance! Do not go close to a monkey) -> Monkeys could feel frightened
- Always act calmly, be quiet. Do not no jump, climb or scream -> Monkeys can get scared
- Look at the monkey, but do not touch!
- Do not look a monkey in the eye -> Monkeys think you are staring, and it makes then uncomfortable
- Do not feed a monkey -> Monkeys get very ill from our food or catch your cold

Appendix E1. Advertisement

Recruitment Adverts

Social media recruitment advert:

We are recruiting children aged 3, 5, 7 and 9 years old and one of their parents / carers to take part in our study titled human perception of monkey facial expressions. For the study you will be invited to play our monkey game! In this game, we will see if you and your child can tell the mood of some monkeys and humans, and whether or not you would like to approach them (no real monkeys will be present). The study will take no longer than 25 minutes for you both to complete and will take place in the Sarah Swift building at the University of Lincoln. If you have an animal phobia or do not see well within a 5-metre distance, we do not recommend you taking part in the study. If you are interested in taking part or have any questions, please contact Laura by email laclark@lincoln.ac.uk. This study has been approved by the University of Lincoln Ethics Committee (reference: 2019-0854).

SONA advertisement

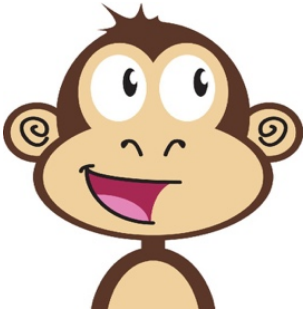
Study name: Human perception of primate facial expressions
Study type: Lab study
Location: Sarah Swift Building
Duration: 25 minutes

Description:
For this study you will be asked to complete two tasks; a computer questionnaire about a selection of monkey and human faces, as well as a practical task where you will be asked questions about five life size cardboard monkey models. This study will take place in the Sarah Swift building. It will take approximately 25 minutes in total for you to complete. Also, if you have a child aged either 3,5,7 or 9 years old and are happy for them to take part in the study please contact the researcher for further details. If you have any animal phobias or cannot see well within a 5-metre distance, we recommend you do not take part in this study.

Researcher:
Laura Clark laclark@lincoln.ac.uk

Project Supervisors:
Dr. Laetitia Marechal LMarechal@lincoln.ac.uk
Prof. Kerstin Meints KMeints@lincoln.ac.uk

UNIVERSITY OF LINCOLN



Participants Wanted!

Children and their parents/carers needed!

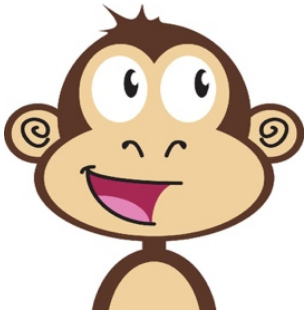
We are recruiting children aged 5 – 10 years old and one of their parents/carers to take part in our study titled human perception of monkey facial expressions.

For the study you will be invited to play our monkey game! In this game, we will see if you and your child can tell the mood of some monkeys and humans, and whether or not you would like to approach them (no real monkeys will be present). The study will take no longer than 25 minutes for you both to complete and will take place in the Sarah Swift building at the University of Lincoln.

If you have an animal phobia or do not see well within a 5-metre distance, we do not recommend you taking part in the study. If you are interested in taking part or have any questions, please contact Laura by email laclark@lincoln.ac.uk. This study has been approved by the University of Lincoln Ethics Committee (reference: 2019-0854).

Thank you!

UNIVERSITY OF LINCOLN



Participants Wanted!

Children and their parents/carers needed!

We are recruiting children aged 5 - 10 years old and one of their parents/carers to take part in our study titled human perception of monkey facial expressions.

For the study you will be invited to play our monkey game! In this game, we will see if you and your child can tell the mood of some monkeys and humans, and whether or not you would like to approach them (no real monkeys will be present). The study will take no longer than 25 minutes for you both to complete and will take place in the Sarah Swift building at the University of Lincoln.

If you have an animal phobia or do not see well within a 5-metre distance, we do not recommend you taking part in the study. If you are interested in taking part or have any questions, please contact Laura by email laclark@lincoln.ac.uk. This study has been approved by the University of Lincoln Ethics Committee (reference: 2019-0854).

Thank you!

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Appendix F1. Questionnaire and Stimuli

Child Questionnaire

Participant ID code

How old are you?

Do you like animals?

- Like very much
- Like a bit
- Neither like nor dislike
- Dislike a bit
- Dislike very much

Do you like monkeys?

- Like very much
- Like a bit
- Neither like nor dislike
- Dislike a bit
- Dislike very much

Do you have a pet?

Yes

No

What pets do you have?

I don't really like animals

Strongly agree

Agree

Not sure

Disagree

Strongly disagree

I spend time everyday playing with my pet

Strongly agree

Agree

Not sure

Disagree

Stongly disagree

I have sometimes talked to my pet and understood what it was trying to tell me

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

I love pets

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

I talk to my pet quite a lot

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

My pet makes me feel happy

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

I consider my pet to be a friend

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

My pet knows when I'm upset and tires to comfort me

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

There are times i'd be lonely without my pet

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

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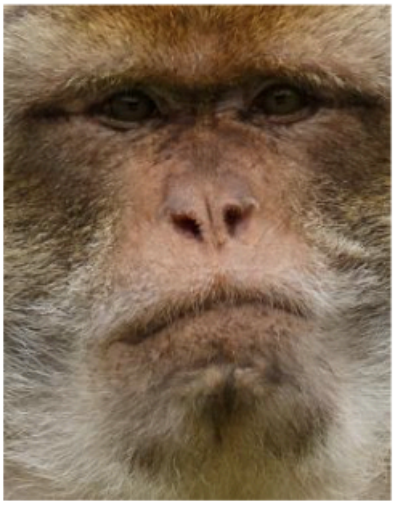


→

27) How is the monkey feeling?

Okay

Scared

Happy

Angry

→

→

5) How is this person feeling?

Happy

Angry

Okay

Scared

→

Adult Questionnaire

Participant number

How old are you?

What is your gender?

Do you like animals?

Like very much	Like a bit	Neither like nor dislike	Dislike a bit	Dislike very much

Do you like monkeys?

Like very much	Like a bit	Neither like nor dislike	Dislike a bit	Dislike very much

Do you have a pet?

- Yes
- No

→

How is this monkey feeling?

- Okay
- Angry
- Happy
- Scared

Please note that:
1 meter = 1 large footstep

How close are you willing to **approach** this monkey?

Touching (0m)	1m	2m	3m	4m	5m	Would not approach

How close are you willing to approach this monkey to **feed** them?

Touching (0m)	1m	2m	3m	4m	5m	Would not approach

How close are you willing to approach this monkey to **take a selfie** with them?

Touching (0m)	1m	2m	3m	4m	5m	Would not approach

How is this person feeling?

- Scared
- Okay
- Happy
- Angry

Please note that:
1 meter = 1 large footstep

How close are you willing to **approach** this person?

Touching (0m)	1m	2m	3m	4m	5m	Would not approach

How close are you willing to approach this person to **feed** them?

Touching (0m)	1m	2m	3m	4m	5m	Would not approach

How close are you willing to approach this person to **take a selfie** with them?

Touching (0m)	1m	2m	3m	4m	5m	Would not approach

Parent/s Report of Child's Attitude and Behavior Towards Animals

This questionnaire has been developed to obtain an account of children's attitudes and behaviors towards animals. After responding to the general questions in Part A, please answer the questions in parts B and C to the best of your knowledge.

PART A

1. What is the name of your child? _____

2. What is your child's date of birth? _____

1. Child Participant Number _____

4. How many pets do your family currently own? _____

5. How many pets did your family own in the past? _____

PART B

7. My child enjoys spending time with animals.

Never Rarely Sometimes Often Always

8. My child has a good relationship with our pet/s.

Not applicable Rarely Sometimes Often Always

9. My child acts in a caring manner towards our pet/s.

Not applicable Rarely Sometimes Often Always

10. My child has ridden a horse.

Not applicable Rarely Sometimes Often Always

11. My child shows responsibility for our pet/s.

Not applicable Rarely Sometimes Often Always

12. My child plays nicely with our pet/s.

Not applicable | Rarely | Sometimes | Often | Always

13. My child is afraid of animals.

Never | Rarely | Sometimes | Often | Always

14. My child likes fishing.

Never | Rarely | Sometimes | Often | Always

PART C

15. My child is rough with animals.

Never | Rarely | Sometimes | Often | Always

16. My child causes harm to animals.

Never | Rarely | Sometimes | Often | Always

17. The last time my child harmed an animal was

Never | More than a year ago | Within the last year | Within the last week | Today

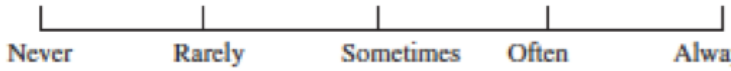
18. My child has harmed:

Small insects	yes	no
Other non-domestic animals	yes	no
Other people's pets	yes	no
His or her pet(s)	yes	no

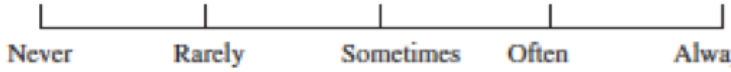
19. My child has harmed animals alone.

Never | Rarely | Sometimes | Often | Always

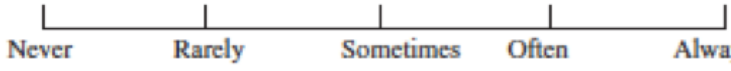
20. My child has harmed animals when he was with another person or in a group.



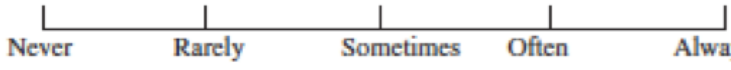
21. My child has harmed animals



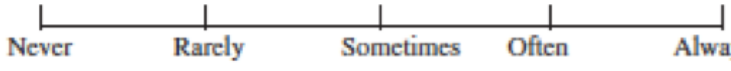
22. My child has shown concern over the suffering of animals



23. I believe that my child has secretly harmed animals:



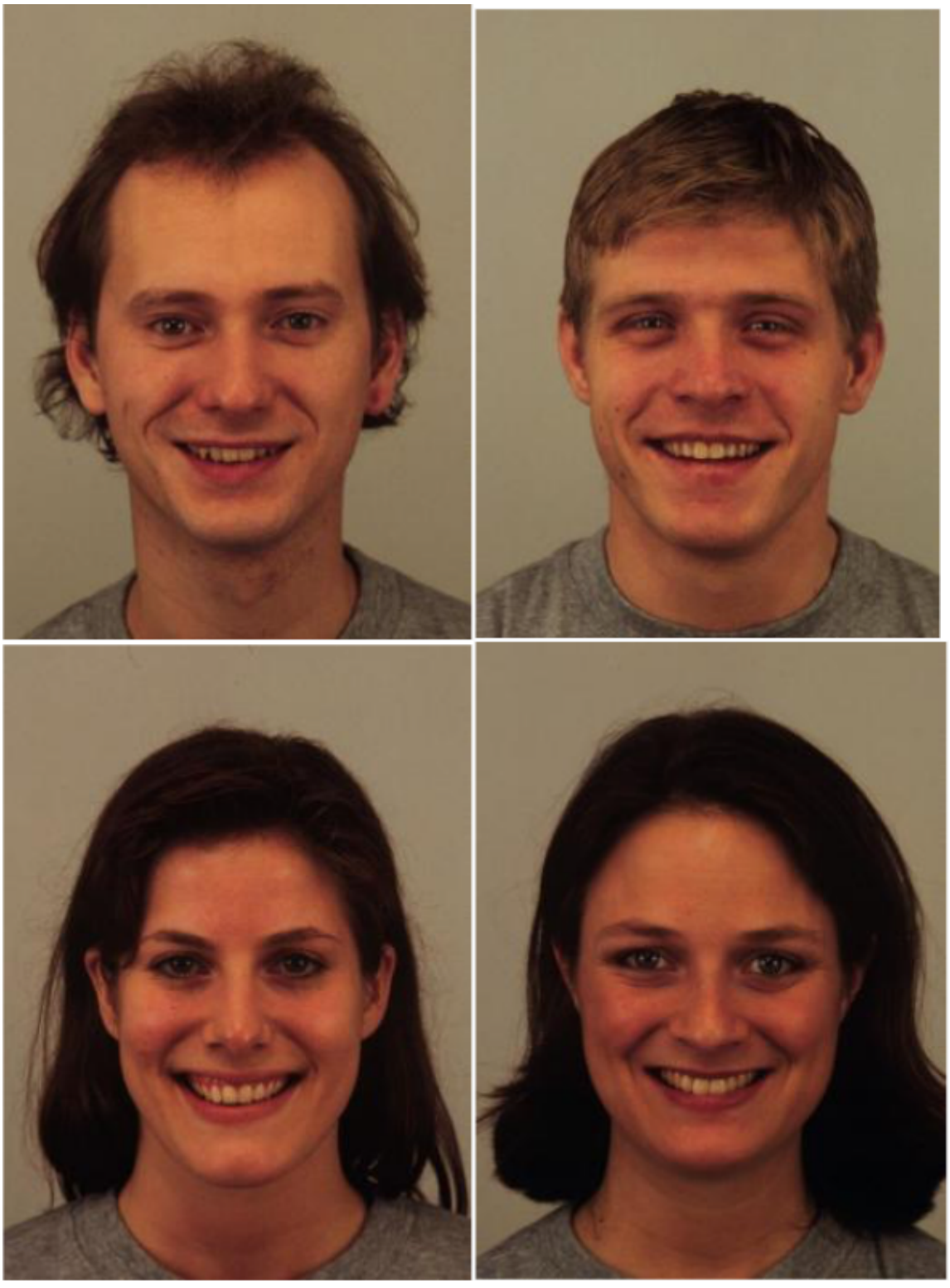
24. My child has shown pleasure when harming animals:

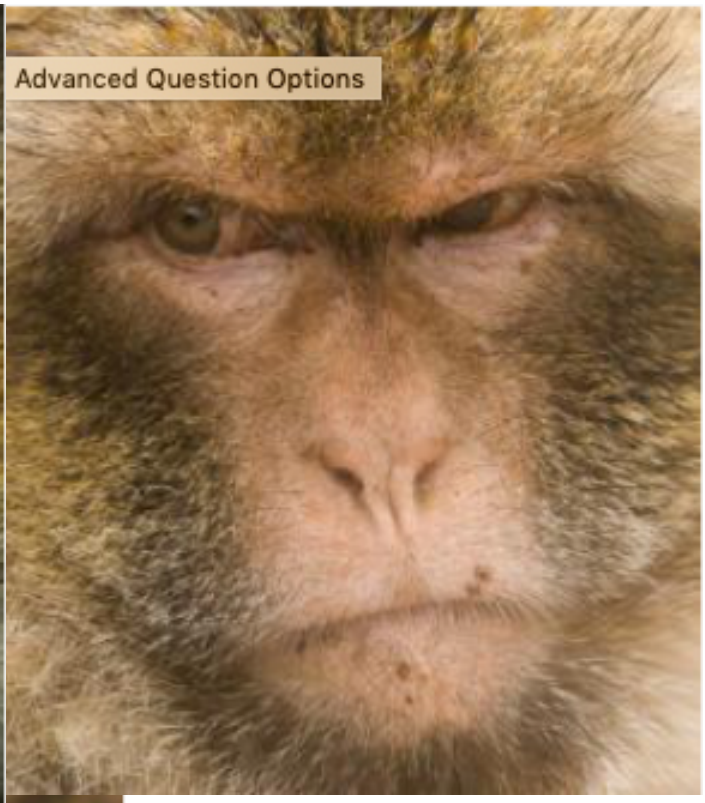


Please indicate your relationship to the child

Mother: _____ Father: _____

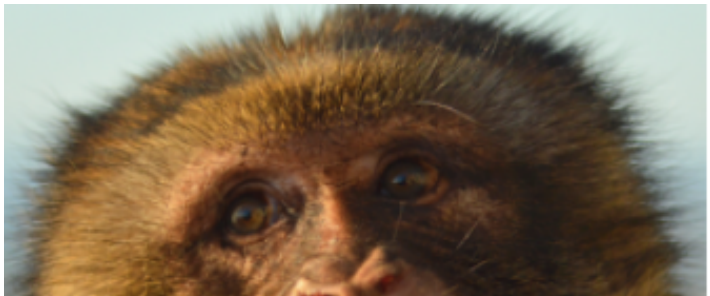
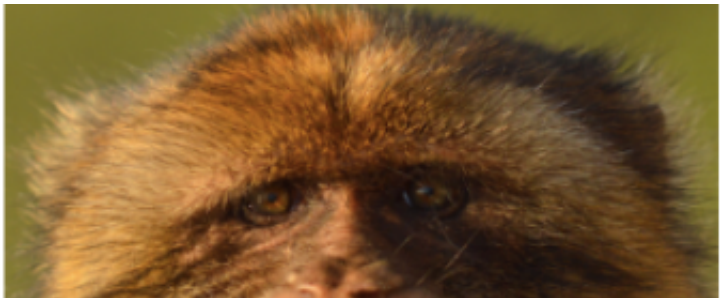
Guardian: _____ Other: _____

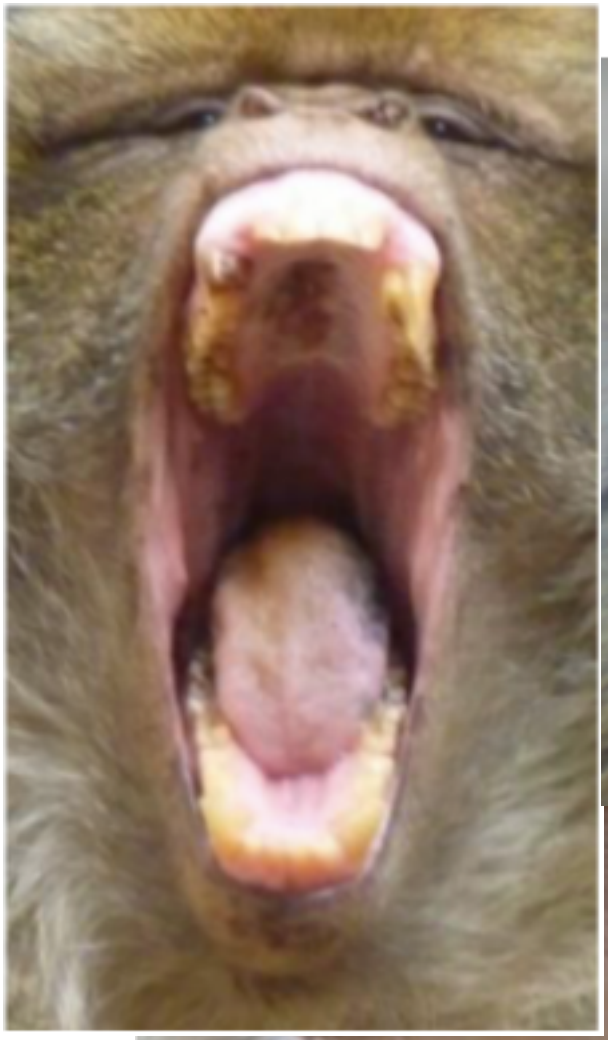



Advanced Question Options







Practical task response forms / script (to be filled in by researcher)
Facial expressions practical task with monkey models

Friendly / Happy = 1
Neutral / Okay = 2
Distressed / Scared = 3
Aggressive / Angry = 4
Very aggressive / Angry= 5

Participant ID =
Monkey order =

"We have five cardboard monkeys for you to look at, let's pretend that these are real monkeys we have found in a jungle. Please stand still on your marker. Now close your eyes." *turn around monkeys* "Now open your eyes and look at each of the monkeys in our jungle. Can you see them ok?"

Yes / No

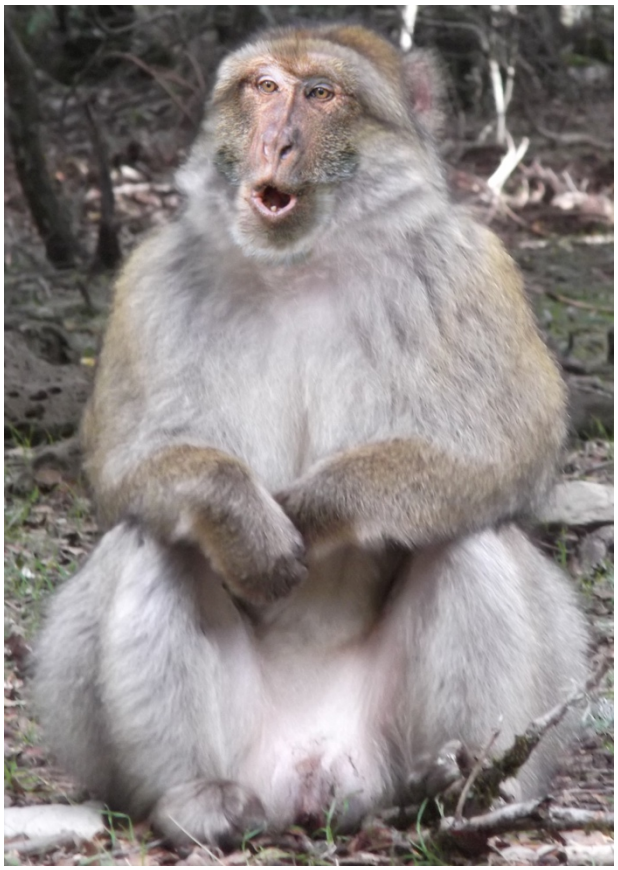
"Which one of these monkeys do you prefer/ like the best?"

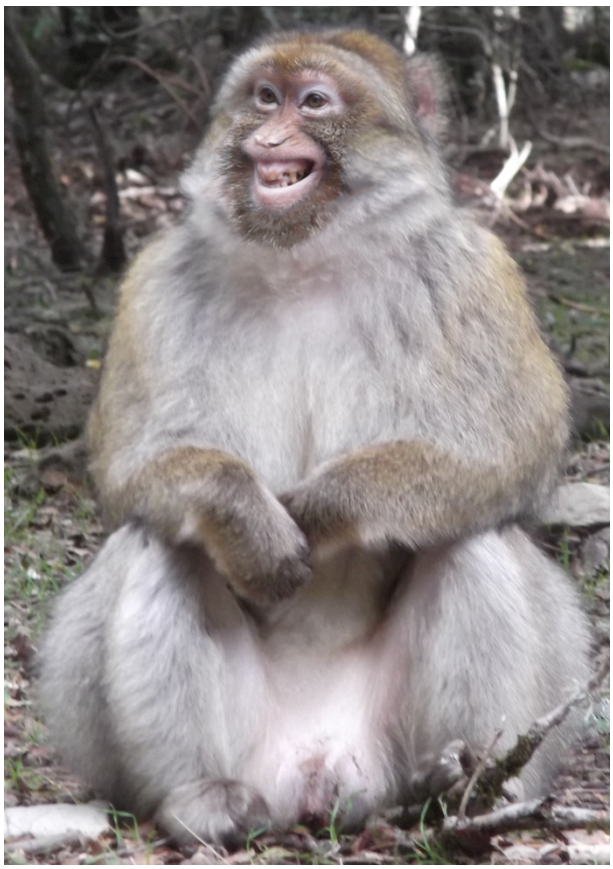
Monkey mood	Layout order	Tick
	1	
	2	
	3	
	4	
	5	

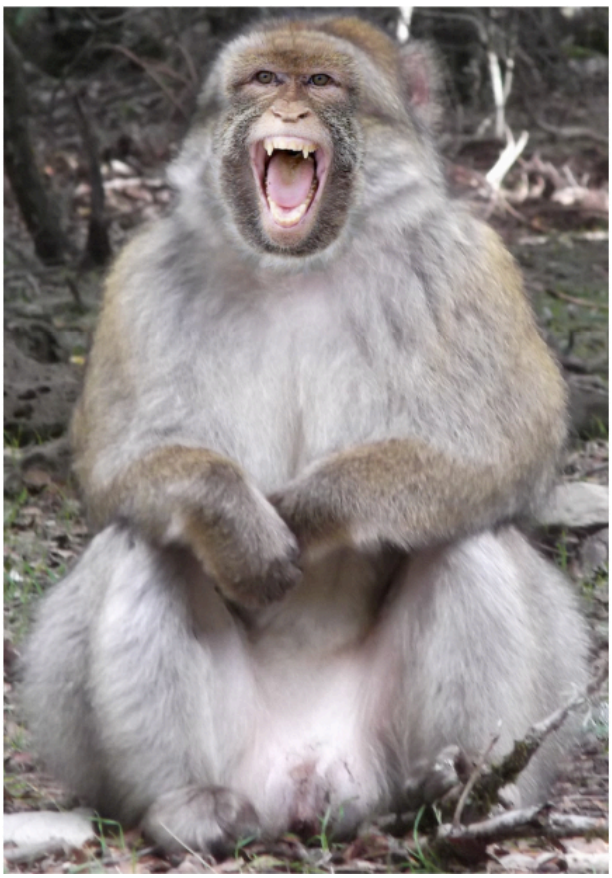
“Why do you like this one the most?”
“How close are you willing to approach each of these monkeys?”
“How do you think each of these monkeys are feeling, happy, angry, scared or okay?”

Monkey mood	Layout order	Distance (m)	Mood (H/A/S/O)
	1		
	2		
	3		
	4		
	5		

Practical task stimuli







One link per appendices – put the link instead

SPSS:
https://universityoflincoln-my.sharepoint.com/:w:/g/personal/14587110_students_lincoln_ac_uk/EXQMTxLSC4tAsewn_zzc-gsB8CnJWsKzQGujg3KzFtTO-A?e=BEtKE1

Appendix A2. Proof of Ethical Approval.

UNIVERSITY OF LINCOLN

Application Details

Ethics Reference	2019-0854
Title of Project	Human perception of primate facial expressions
Lead Researcher	Laura Clark
Academic Supervisor	
Date of Amendment Ethical Opinion	18 December 2019

Favourable Opinion

Thank you for your amendment, I am pleased to confirm a favourable ethical opinion for the amendment to the above research on the basis described in the amendment form and supporting documentation (if submitted).

Please refer to your original favourable opinion letter for any conditions of approval.

Yours Sincerely

[*Letter not signed*]

Dr Amanda Roberts

On behalf of University Human/Non-Human Research Ethics Committee Admin

Approved list of documents: If submitted

Document Type	File Name	Date	Version
Other documents	Human Perception of primate facial expressions, English and Spanish Stimuli, 16.12.19	16/12/2019	1
Other documents	Human perception of primate facial expressions, English and Spanish Consent Forms, 16.12.19	16/12/2019	1
Other documents	Human perception of primate facial expressions, English and Spanish Debrief, 16.12.2019	16/12/2019	1
Other documents	Human perception of primate facial expressions, English and Spanish Information Sheet, 16.12.19	16/12/2019	1
Other documents	Human perception of primate facial expressions, English Recruitment, 16.12.19	16/12/2019	1

Appendix B2. Brief.

Participant Information Sheet/Information about the research
(Draft version 01 / Final version 1.0: 16/12/19)

Title of Study: What is this monkey feeling?
Name of Researcher(s): Laetitia Marechal, Laura Clark, Barbara Tiddi, Kerstin Meints
Contact Details of the Researcher(s) are given at the end.

We'd like to invite you to take part in our research study. Joining the study is entirely up to you. Before you decide, we would like you to understand why the research is being done and what it would involve for you. Please read through this information sheet, to help you decide whether or not you would like to take part. We suggest this should take about 5 minutes. Please feel free to talk to others about the study if you wish.

What is the purpose of the study?

Both humans and monkeys communicate their emotions through facial expressions. Depending on how they are recognised, these facial expressions can influence how people will act. In this study, we will see whether people from the UK and Argentina can tell the mood of some monkeys from pictures, and from this whether they would approach them or not. From this study we aim to assess whether there is a difference in how people from different cultures perceive monkey facial expressions and if these facial expressions also influence how we act around the animal. This is an online study to be self-administered via an access link.

Why have I been invited?

You are being invited to take part because you are over 18 years of age, have volunteered via one of our ads and reside in either the UK or Argentina. We are inviting 200 participants like you to take part.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will be asked to give consent on this questionnaire. If you decide to take part you are still free to withdraw at any time and without giving a reason. This would not affect your legal rights.

What will happen to me if I take part?

After reading this information sheet, if you are happy to take part in this study you will be asked for your consent on this questionnaire. We will then ask for some basic demographic information and your experience with animals. Then you will be shown images of various monkeys, you will be asked how you think these monkeys are feeling using the options of happy, angry, scared and okay, and how confident you are in in your answer. Then you will be asked how close you are willing to approach, approach to feed and approach to take a selfie with each of the monkeys using a scale from 0m to 10m, with an option not to approach. There will be many images of monkeys and this should take you approximately 25 minutes.

As mentioned, images of monkeys will be used, if you have any animal specific phobias, we recommended you do not take part in this study.

Expenses and payments

You will not be paid to participate in the study, your participation is voluntary.

What are the possible disadvantages and risks of taking part?

If you have any animal specific phobias the images used in this study may cause you distress and we recommend you not to take part if that is the case.

What are the possible benefits of taking part?

There will be no direct benefits from taking part in this study, but hopefully the knowledge that you are helping us to conduct research that should lead to a better understanding of wildlife tourism. If you are a psychology student from the University of Lincoln, and have signed up via the University of Lincoln' SONA system you will receive 1 point for completing this study.

Will my taking part in the study be kept confidential?

We will follow ethical and legal practice and all information about you will be handled in confidence. The study is totally anonymous.

Privacy notice

The University of Lincoln is the lead organisation for this study and will be the data controller for this study. This means that we are responsible for looking after your information and using it properly. The university's Research Participant Privacy Notice https://ethics.lincoln.ac.uk/research-privacy-notice/ will explain how we will be using information from you in order to undertake this study.

What will happen if I don't want to carry on with the study?

Your participation is voluntary, and you are free to withdraw at any time, without giving any reason, and without your legal rights being affected. As your participation is anonymous it will not be possible to withdraw your data once submitted, as I/we have no way of identifying you.

Where will my data be stored?

The data obtained from the study will be stored securely on the university OneDrive in a password protected file. Only the researcher/researchers will have access to it. The data from this study *may* be put in an Open Access repository. If so, any personal data (e.g. contact details) will be removed.

What will happen to the results of the research study?

Data will be treated confidentially and any publication resulting from this study will report only data that does not identify individual participants (unless you have agreed to be identified). Participants' anonymised responses, however, may be shared with other researchers or made available in online data repositories.

Who is organising and funding the research?

This research is being organised by the University of Lincoln.

Who has reviewed the study?

All research conducted by the University of Lincoln is looked at by an independent group of people, called a Research Ethics Committee, to protect your interests.

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to the researchers, who will do their best to answer your questions. The researcher's contact details are given at the end of this information sheet. If you remain unhappy and wish to complain formally, you can do this by contacting ethics@lincoln.ac.uk.

If you feel that we have let you down in relation to your information rights then please contact the Information Compliance team by email on compliance@lincoln.ac.uk or by post at Information Compliance, Secretariat, University of Lincoln, Brayford Pool, Lincoln, LN6 7TS.

You can also make complaints directly to the Information Commissioner's Office (ICO). The ICO is the independent authority upholding information rights for the UK. Their website is ico.org.uk and their telephone helpline number is 0303 123 1113.

Further information and contact details

Laetitia Marechal, lmarechal@lincoln.ac.uk
Laura Clark, laclark@lincoln.ac.uk
Barbara Tiddi, B.Tiddi@kent.ac.uk
Kerstin Meints, kmeints@lincoln.ac.uk

Nota informativa para los participantes/Información sobre la investigación
(Versión borrador 01 / Versión final 1.0: 16/12/19)

Titulo del estudio: ¿Qué siente este mono?
Nombres de las investigadoras: Laetitia Marechal, Laura Clark, Barbara Tiddi, Kerstin Meints
Los contactos de las investigadoras están al final.

Nos gustaría invitarles a participar en nuestro estudio de investigación. Participar en el estudio depende totalmente de ustedes. Ante de decidir, nos gustaría explicarles por que estamos realizando este estudio y que implicaría para ustedes. Lean por favor esta nota informativa (necesitan aproximadamente 5 minutos) para decidir si desean participar, y si lo desea, siéntanse libres de hablar con otros acerca de este estudio.

¿Cuál es el objetivo de este estudio?

Los monos, igual que nosotros, comunican sus emociones a través de expresiones faciales. Dependiendo de cómo se clasifican, estas expresiones faciales pueden influir en como las personas interactuarán con los monos. Lo que queremos ver en este estudio es si las personas que viven el Reino Unido y en Argentina pueden distinguir la emoción de algunos monos a partir de sus fotos, y en base a esto si se acercarían a ellos o no. Por lo tanto, nuestro objetivo es evaluar si las expresiones faciales de los monos influyen en como actuamos alrededor del animal, y además si hay una diferencia en como las personas de

diferentes países perciben estas expresiones faciales. Este es un estudio online al que se puede acceder a través de un weblink.

¿Porqué han sido contactados?

Ustedes han sido invitados a participar porque tienen mas de 18 años, han sido voluntarios a través de uno de nuestros anuncios, y viven en el Reino Unido o en Argentina. Estamos buscando 200 voluntarios como ustedes para participar.

¿Tienen que participar?

Ustedes pueden decidir si participar o no. Si quieren participar, se les pedirá sus consentimientos en el cuestionario adjunto. pueden retirarse en cualquier momento sin dar una razón. La decisión de retirarse no afectaría sus derechos legales.

¿Qué les pasará si participan?

Despues haber leído esta nota de información, si están de acuerdo y quieren participar en el estudio, se les pedirá sus consentimientos en el cuestionario adjunto. Luego les pediremos información demográfica básica y su experiencia con los animales. En seguida se les mostraran fotos de varios monos, se les preguntará como cree que se sienten estos monos usando las opciones “contento, enojado, asustado o tranquilo”, y además se les preguntará que tan seguro está en sus respuestas. Para finalizar, se les preguntará que tan cerca están dispuesto a aproximarse a este mono, acercarse para dar comida o acercarse para tomar una selfi con este mono usando una escala que va de 0m hasta 10m (hay también una opción que es “no acercarse”). Encontrarán en el cuestionario muchas fotos de monos y estimamos que necesitarán aproximadamente 15 minutos para terminarlo. Como ya se mencionó, se utilizarán fotos de monos, así que, si tienen fobias, les recomendamos que no participen en esto estudio.

Gastos y pagos

Su participación es voluntaria y no se les pagarán para participar.

¿Participar implica posibles desventajas y riesgos?

Si tienen fobias específicas hacia los animales, las imágenes utilizadas en este estudio pueden causarles angustia y le recomendamos que no participe si ese es el caso.

¿Cuáles son los posibles beneficios de participar?

No habrá beneficios directos de particiapr en este estudio, pero lo que esperamos es que el conocimiento que nos están ayudando a lograr debería conducir a un mejor manejo de la interacción entre la vida silvestre y el turismo. Si ustedes son estudiantes de Psicología de la Universidad de Lincoln (UK) y se han inscrito a través del sistema SONA, recibirán 1 punto por completar este estudio.

¿Sus participaciones en esto estudio se mantendrán confidencial?

Seguiremos la practica ética y legal y toda la información sobre ustedes serán tratadas de manera confidencial. El estudio es totalmente anónimo.

Aviso sobre la privacidad

La Universidad de Lincoln (UK) es la organización principal de este estudio y será la administradora de los datos Esto significa que somos responsables de cuidar sus informaciones y usarlas adecuadamente. En el siguiente link se encuentra la política de privacidad del participante de investigación de la Universidad https://ethics.lincoln.ac.uk/research-privacy-notice/ y se explicara como utilizaremos sus informaciones para llevar a cabo este estudio.

¿Qué pasa si no quieren continuar con el estudio?

Sus participaciones son voluntarias y pueden retirarse en cualquier momento, sin dar ninguna razón y sin que sus derechos legales se vean afectados. Dado que sus participaciones son anónimas, no será posible retirar sus datos una vez enviados, ya que nosotros/ustedes no tenemos forma de identificarlo.

¿Dónde se guardarán sus datos?

Los datos conseguidos en este estudio serán guardados de forma segura en el OneDrive de la Universidad en un archivo protegido con contraseña al que solo pueden acceder el investigador/los investigadores. Puede ser que estos datos sean publicados en una carpeta compartida de acceso libre. En esto caso, se eliminarán todos los datos personales (por ejemplo, datos de contacto).

¿Qué se hará con los resultados del estudio de investigación?

Los datos se tratarán de forma confidencial y cualquier publicación resultante de este estudio contendrá solo datos que no identifiquen los individuos (a menos que haya aceptado ser identificado). Sin embargo, las respuestas anónimas de los participantes podrían compartirse con otros investigadores o subirse en carpetas compartidas en línea.

¿Quién organiza y financia la investigación?

Esta investigación esta siendo organizada por la Universidad de Lincoln y la de Kent.

¿Quién ha revisado el estudio?

Todas las investigaciones realizadas por la Universidad de Lincoln son analizadas por un grupo independiente de personas, llamado Comité de Ética de Investigación, para proteger sus intereses.

¿Y si hay un problema?

Si le preocupa algún aspecto de este estudio, debe pedir de hablar con los investigadores, quienes harán todo lo posible para responder a sus preguntas. Los datos de contacto del investigador se encuentran al final de esta hoja de información. Si siguen descontentos y desean presentar una queja formal puede harcelo comunicándose con ethics@lincoln.ac.uk.

Si creen que los hemos defraudados en relación con sus derechos de información, comuníquese con el equipo de Information Compliance por correo electrónico a compliance@lincoln.ac.uk o por correo postal a Information Compliance, Secretariat, University of Lincoln, Brayford Pool, Lincoln, LN6 7TS.

Ustedes pueden también presentar quejas directamente a la oficina del Comisionado de Información (ICO). El ICO es la autoridad independiente que defiende los derechos de información para el Reino Unido. Su sitio wen es ico.org.uk y su teléfono es 0303 123 1113.

Mas información y datos de contacto de las investigadoras

Laetitia Marechal, lmarechal@lincoln.ac.uk
Laura Clark, laclark@lincoln.ac.uk
Barbara Tiddi, B.Tiddi@kent.ac.uk
Kerstin Meints, kmeints@lincoln.ac.uk

Appendix C2. Consent Form.

Project ID:

Participant Identification Number for this study:

CONSENT TO PARTICIPATE IN RESEARCH

Title of Project: How is this monkey feeling?

Name of Researcher: Laetitia Marechal, Laura Clark, Barbara Tiddi, Kerstin Meints

Name of Participant:

Please initial box

13. I confirm that I have read the information sheet dated 16/12/19 (version 01) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

14. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected. I understand that should I withdraw then the information collected so far may not be erased and that this information may still be used in the project analysis. ☐

15. I understand that individuals from the University of Lincoln may look at research data collected during the study, to ensure that the study is conducted appropriately. I give permission for these individuals to have access to my records; I understand that my personal details shall be kept confidential. ☐

16. I understand that the information collected about me will be used to support other research in the future, and may be shared anonymously with other researchers.

17. I would like to receive a summary of the results of the study Yes ☐ No ☐

18. I agree to take part in the above study.

Name of Participant	Date	Signature
Name of Person taking consent	Date	Signature

Proyecto ID:

Numero de identificación del participante en el estudio:

CONSENTIMIENTO PARA PARTICIPAR EN EL ESTUDIO

Titulo del estudio: ¿Qué siente este mono?

Nombres de las investigadoras: Laetitia Marechal, Laura Clark, Barbara Tiddi, Kerstin Meints

Nombre del participante:

Por favor caja inicial

19. Confirmo que he leído la nota de información con fecha 16/12/19 (versión 01) para el estudio acá mencionado. He tenido la oportunidad de considerar la información, preguntar dudas y recibir respuestas satisfactorias.

20. Entiendo que mi participación es voluntaria y que soy libre de retirarme en cualquier momento sin dar ninguna explicación, sin que mis derechos legales se vean afectados. Entiendo también que, si decido de retirarme, la información coleccionada hasta esto momento puede no borrarse y que esta información aún puede usarse en el análisis del proyecto.

21. Entiendo que las personas de la Universidad de Lincoln pueden ver los datos collecionados durante el proyecto para asegurarse de que el estudio se realice de manera adecuada. Doy mi permiso para que estas personas tergna acceso a mis registros, y entiendo que mis datos personales se mantendrán confidenciales.

22. Entiendo que la información coleccionada sobre mi se utilizará para apoyar otra investigación en el futuro, y puede ser compartida anónimamente con otros investigadores.

23. Acepto participar en el estudio acá mencionado.

Nombre del participante	Fecha	Firma
Nombre de la persona que toma el consentimiento	Fecha	Firma

Appendix D2. Debrief.

Participant Debrief Sheet

(Draft Version 01 / Final version 1.0: 16/12/19)
Title of Study: What is this monkey feeling?
Name of Researcher(s): Laetitia Marechal, Laura Clark, Barbara Tiddi, Kerstin Meints
Contact Details of the Researcher(s) are given at the end.

We'd like to thank you for taking part in our research study. This research will provide crucial information and broaden our understanding of the human perception of monkey facial expressions across cultures.

What was the aim of the study?
We have previously found out that people often misunderstand monkey facial expressions. For example, people have mistaken an aggressive face with a friendly face. We now want to learn if people from parts of the world who have more exposure to monkeys will interpret the monkey facial expressions differently to those who have little exposure. This will provide us with more information on the processes behind our ability to recognise facial expressions

across species and therefore allow us to develop education tools to teach about monkeys' facial signals and how to interpret them correctly. This is needed as according to the World Health Organisation monkey bites are the second most common animal bite risk to travellers, developing a safety tool will hopefully keep everyone safer in wildlife tourism around the world.

As you saw images of monkeys (Capuchins), we must emphasise the importance of safety with wild animals. Please do not approach any monkey, especially within 10 metres, for any activity such as to take photos of yourself. Please never feed any monkey under any circumstance.

Questions and withdrawing
If you have any further questions about the study, please feel free to ask the researcher before you finish or alternatively contact the researcher or their supervisor at any time on lmarechal@lincoln.ac.uk.

If you have submitted your data anonymously then it will not be possible to withdraw your data, as we will be unable to identify your responses.

Further help and support
If you have any ethical concerns regarding the current research, your treatment as a participant or your involvement in the study please feel free to contact ethics@lincoln.ac.uk.
If you have been affected by any of the issues raised by taking part in this study the following organisations may be able to provide help and advice:
MIND Phobias Factsheet: mind.org.uk or 03001233390
Contact Details of Researcher(s)
Laetitia Marechal, lmarechal@lincoln.ac.uk
Laura Clark, laclark@lincoln.ac.uk
Barbara Tiddi, B.Tiddi@kent.ac.uk
Kerstin Meints, kmeints@lincoln.ac.uk

Resume del proyecto para el participante

(Versión borrador 01 / Versión final 1.0: 16/12/19)
Titulo del estudio: ¿Qué siente este mono?
Nombres de las investigadoras: Laetitia Marechal, Laura Clark, Barbara Tiddi, Kerstin Meints
Los contactos de las investigadoras están al final.

Nos gustaría agradecerle para participar en nuestro estudio de investigación. Esta investigación ayudará a reunir información crucial y a ampliar nuestra compresión de la percepción humana de las expresiones faciales de los monos entre diferentes culturas.

¿Cuál es el objetivo de esto estudio?

En uno estudio anterior hemos descubierto que las personas a menudo no comprenden las expresiones faciales de los monos. Por ejemplo, las personas parecen confundir una cara

agresiva con una cara amigable. En este estudio, queremos sabes si las personas de otras partes del mundo que están mas expuestas a los monos interpretarán las expresiones faciales de los monos de manera diferente a las que tienen poca exposición. Esto nos ayudará a reunir mas información sobre los procesos detrás de nuestra capacidad de reconocer las expresiones faciales en las especies y, por lo tanto, nos permitirá desarrollar herramientas educativas para enseñar a la gente cuales son las señales faciales de los monos y como interpretarlas correctamente. Esto es muy importante ya que, según la Organización Mundial de la Salud, las mordidas de mono son el segundo riesgo de mordida de animales más común para los turistas; entonces, desarrollar una herramienta de seguridad servirá a disminuir el riesgo de accidentes en presencia de animales silvestres y aumentar la seguridad de los turistas.

Como vio fotos de monos (monos capuchinos), debemos enfatizar la importancia de la seguridad en presencia de animales silvestres. No se acerque a ningún mono, especialmente a menos de 10 metros, para realizar actividades como tomarse fotos. Por favor, nunca alimentes a ningún mono en ninguna circunstancia.

Preguntas y retiros
Si tiene más preguntas sobre el estudio, por favor contáctense con el investigador antes de terminar el cuestionario. Alternativamente, contáctense con el investigador o su supervisor en cualquier momento en lmarechal@lincoln.ac.uk.

Si ha enviado sus datos de forma anónima, no será posible retirarlos, ya que no podremos identificar sus respuestas.

Ulterior ayuda y apoyo
Si necesitas aclarar algo sobre la ética de la investigación actual, su tratamiento como participante o su participación en el estudio, no dude en ponerse en contacto ethics@lincoln.ac.uk.
Participando en esto estudio, si se ha visto afectado por algunos problemas, las siguientes organizaciones pueden ayudarle y avisarle:
MIND Phobias Factsheet: mind.org.uk or 03001233390
Contacto de las investigadoras
Laetitia Marechal, lmarechal@lincoln.ac.uk
Laura Clark, laclark@lincoln.ac.uk
Barbara Tiddi, B.Tiddi@kent.ac.uk
Kerstin Meints, kmeints@lincoln.ac.uk

Appendix E2. Advertisement.

Social media recruitment advert:

We would like to invite you to take part in our study – how is this monkey feeling?
The study looks at how humans perceive monkeys and should take no longer than 25 minutes to complete. You will be shown pictures of monkeys and asked some multiple-choice questions on how you think each monkey is feeling and how you would behave towards each monkey pictured. If you have any animal phobias, we recommend you do not take part in this study. You must be over the age of 18, and all responses are confidential and anonymous. To take part please click the link below.

Nos gustaría invitarle a participar en nuestro estudio: ¿ Como se siente este mono?. El estudio analiza cómo los humanos perciben a los monos y no debería demorar más de 25 minutos en completarse. Se le mostrarán fotos de monos y se le harán algunas preguntas

de opción multiple sobre como piensa que se siente cada mono y como se comportaría con cada mono ilustrado. Si tiene fobias hacia los animales, le recomendamos que no participeen este estudio. Debe también tener mas de 18 años y todas las respuestas son confidenciales y anónimas. Para participar, clique el siguiente link.

SONA advertisement

Study name: How is this monkey feeling?
Study type: Online Questionnaire
Duration: 25 minutes

Description:
This 25-minute questionnaire will investigate how humans behave in relation to wild monkeys. You will be shown pictures of monkeys and then asked some multiple-choice questions on how you perceive and would behave towards each monkey pictured. Compatible on all devices. If you have any animal phobias, we recommend you do not take part in this study.

Researchers:
Laetitia Marechal, lmarechal@lincoln.ac.uk
Laura Clark, laclark@lincoln.ac.uk
Barbara Tiddi, B.Tiddi@kent.ac.uk
Kerstin Meints, kmeints@lincoln.ac.uk

Appendix F2. Questionnaires and Stimuli.

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English - United Kingdom

How old are you? (in years)

Which gender do you identify yourself as?

What is your nationality?

What country do you currently live in?

How long have you lived in this country?

Español (América Latina)

¿Cuántos años tienes? (en años)

¿De qué género te identificas?

¿Cual es tu nacionalidad?

Have you ever studied or worked in non-human animal related activities? e.g. animal behaviourist, vet, animal trainer

Have you ever studied or worked in non-human primate related activities? e.g. primatologist

Have you ever studied or worked with capuchin monkeys? If yes, how long?

Have you ever encountered live capuchin monkeys? If yes please indicate where and how many times?

¿En qué país vive actualmente?

¿Cuánto tiempo has vivido en este país?

¿Tienes experiencia estudiando o trabajando en tareas relacionadas con animales no humanos? E.j. Especialista en conportamiento animal, veterinario entrenador de animales.

¿Tienes experiencia estudiando o trabajando en actividades relacionadas con primates no humanos?E.j. primatologo

¿Tienes experiencia estudiando o trabajando con monos capuchinos? Si si, cuanto tiempo?

Based on the scale below, how confident are you in your knowledge about capuchin monkeys?

Unconfident Confident
0 20 40 60 80 100

Confidence

Based on the scale below, how much do you think you like non-human animals?

Dislike Like
0 20 40 60 80 100

Non-human animals

Based on the scale below, how much do you think you like non-human primates?

Dislike Like
0 20 40 60 80 100

Non-Human primates

¿Te has encontrado nunca con monos capuchinos vivos? En caso afirmativo, indique donde y cuantas veces por favor.

Según la escala abajo, ¿qué tan seguro esta de su conocimiento sobre los monos capuchinos?

Desconfiado — Confidente
0 20 40 60 80 100

Confianza

Según la escala abajo, ¿cuánto crees que te gustan los animales no humanos?

Disgusto — Me gusta
0 20 40 60 80 100

Animales no humanos

Según la escala abajo, ¿cuánto crees que te gustan los primates no humanos?

Disgusto — Me gusta
0 20 40 60 80 100

Primates no humanos

How is this monkey feeling?

- Angry
- Scared
- Okay
- Happy

How confident are you in your answer?

Unconfident 0 20 40 60 80 Confident 100

Confidence

¿Qué siente este mono?

Contento

Tranquilo

Enojado

Asustado

¿Cuánto confía en tu respuesta?

Desconfiado 0 20 40 60 80 Confidente 100

Confianza

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How close are you willing to **approach** this monkey? From 0m (touching) to 10m or would not approach. Please note that 1m = 1 large footstep.

0 1 2 3 4 5 6 7 8 9 10

Approach Distance (0m-10m) ☐ Would not approach

¿Cuánto cerca estás dispuesto a acercarte a este mono para alimentarlo? Elija una medida de 0m (tocar) a 10m, o no se acercaría. Tenga en cuenta que por lo general 1m= 1 paso grande.

0 1 2 3 4 5 6 7 8 9 10

Distancia de acercamiento (0m-10m) ☐ No me acercaría

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How close are you willing to approach this monkey to **feed** it? From 0m (touching) to 10m or would not approach. Please not that 1m = 1 large footstep.

0 1 2 3 4 5 6 7 8 9 10

Approach to Feed Distance (0m-10m) ☐ Would not approach

¿Cuánto cerca estás dispuesto a acercarte a este mono? Elija una medida de 0m (tocar) a 10m, o no se acercaría. Tenga en cuenta que por lo general 1m= 1 paso grande.

0 1 2 3 4 5 6 7 8 9 10

Distancia de acercamiento (0m-10m) ☐ No me acercaría

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How close are you willing to approach this monkey to take a **selfie** with it? From 0m (touching) to 10m or Would not approach. Please note that 1m = 1 large footstep.

0 1 2 3 4 5 6 7 8 9 10

Approach to take a Selfie Distance (0m-10m) ☐ Would not approach

¿Cuánto cerca estás dispuesto a acercarte a este mono para tomarse una selfi? Elija una medida de 0m (tocar) a 10m, o no se acercaría. Tenga en cuenta que por lo general 1m= 1 paso grande.

0 1 2 3 4 5 6 7 8 9 10

Distancia de acercamiento (0m-10m) ☐ No me acercaría

Appendix G1. SPSS Output

Child Age and Gender

			Frequency	Percent	Valid Percent	Cumulative Percent
4	Valid	M	1	33.3	33.3	33.3
		F	2	66.7	66.7	100.0
		Total	3	100.0	100.0	
5	Valid	M	12	48.0	48.0	48.0
		F	13	52.0	52.0	100.0
		Total	25	100.0	100.0	
6	Valid	F	2	100.0	100.0	100.0
7	Valid	M	11	44.0	44.0	44.0
		F	14	56.0	56.0	100.0
		Total	25	100.0	100.0	
8	Valid	M	2	50.0	50.0	50.0
		F	2	50.0	50.0	100.0
		Total	4	100.0	100.0	
9	Valid	M	7	43.8	43.8	43.8
		F	9	56.3	56.3	100.0
		Total	16	100.0	100.0	
10	Valid	M	2	33.3	33.3	33.3
		F	4	66.7	66.7	100.0
		Total	6	100.0	100.0	

Gender

Age			Frequency	Percent	Valid Percent	Cumulative Percent
Student	Valid	Male	18	40.0	40.0	40.0
		Female	27	60.0	60.0	100.0
		Total	45	100.0	100.0	
Parent	Valid	Male	8	13.8	13.8	13.8
		Female	50	86.2	86.2	100.0
		Total	58	100.0	100.0	

Descriptive Statistics

Age		N	Minimum	Maximum	Mean	Std. Deviation
Student	Age	45	18.00	22.00	19.4444	.91839
	Gender	45	1.00	2.00	1.6000	.49543
	Valid N	45				
Parent	Age	58	26.00	66.00	37.4655	7.04177
	Gender	58	1.00	2.00	1.8621	.34784
	Valid N	58				

Two way all ages correct practical ANOVA

Descriptive Statistics

Dependent Variable: Correct

Age Group	Gender	Mean	Std. Deviation	N
4-6	Male	1.5385	.77625	13
	Female	1.2941	1.15999	17
	Total	1.4000	1.00344	30
7-8	Male	1.3077	.75107	13
	Female	1.2500	1.06458	16
	Total	1.2759	.92182	29
9-10	Male	1.1111	.78174	9
	Female	1.5385	.77625	13
	Total	1.3636	.78954	22
18-22	Male	1.3889	.91644	18
	Female	2.0370	.93978	27
	Total	1.7778	.97442	45
25+	Male	1.7500	1.03510	8
	Female	1.9800	1.02000	50
	Total	1.9483	1.01605	58
Total	Male	1.4098	.84414	61
	Female	1.7561	1.04286	123

Total	1.6413	.99267	184

Tests of Between-Subjects Effects

Dependent Variable: Correct

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	19.956[a]	9	2.217	2.406	.014	.111
Intercept	329.499	1	329.499	357.503	.000	.673
AgeGroup	7.596	4	1.899	2.060	.088	.045
Gender	1.437	1	1.437	1.559	.213	.009
AgeGroup * Gender	4.347	4	1.087	1.179	.322	.026
Error	160.370	174	.922			
Total	676.000	184				
Corrected Total	180.326	183				

a. R Squared = .111 (Adjusted R Squared = .065)

Child practical task Confusion Matrix – Table 1
Child

Friendly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	1	1.4	1.4	1.4
	Happy	57	77.0	77.0	78.4
	Okay	15	20.3	20.3	98.6
	Scared	1	1.4	1.4	100.0
	Total	74	100.0	100.0	

Neutral

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	49	66.2	66.2	66.2
	Happy	4	5.4	5.4	71.6
	Okay	15	20.3	20.3	91.9
	Scared	6	8.1	8.1	100.0
	Total	74	100.0	100.0	

Distressed

Aggressive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	6	8.1	8.1	8.1
	Happy	8	10.8	10.8	18.9
	Okay	39	54.1	54.1	73.0
	Scared	20	27.0	27.0	100.0
	Total	74	100.0	100.0	

Very Aggressive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	18	24.3	24.3	24.3
	Happy	24	32.4	32.4	56.8
	Okay	8	10.8	10.8	67.6
	Scared	24	32.4	32.4	100.0
	Total	74	100.0	100.0	

Student

Friendly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	2	4.4	4.4	4.4
	Happy	29	64.4	64.4	68.9
	Okay	5	11.1	11.1	80.0
	Scared	9	20.0	20.0	100.0
	Total	45	100.0	100.0	

Neutral

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	23	51.1	51.1	51.1
	Okay	20	44.4	44.4	95.6
	Scared	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

Distressed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Happy	40	88.9	88.9	88.9
	Okay	1	2.2	2.2	91.1
	Scared	4	8.9	8.9	100.0
	Total	45	100.0	100.0	

Aggressive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Happy	4	8.9	8.9	8.9
	Okay	32	71.1	71.1	80.0
	Scared	9	20.0	20.0	100.0
	Total	45	100.0	100.0	

Very Aggressive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	27	60.0	60.0	60.0
	Happy	7	15.6	15.6	75.6
	Okay	2	4.4	4.4	80.0
	Scared	9	20.0	20.0	100.0
	Total	45	100.0	100.0	

Adult

Friendly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	1	1.7	1.7	1.7
	Happy	36	62.1	62.1	63.8
	Okay	9	15.5	15.5	79.3
	Scared	11	20.7	20.7	100.0
	Total	58	100.0	100.0	

Neutral

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	22	37.9	37.9	37.9
	Happy	1	1.7	1.7	39.7
	Okay	29	50.0	50.0	89.7
	Scared	5	10.3	10.3	100.0
	Total	58	100.0	100.0	

Distressed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	3	5.2	5.2	5.2
	Happy	35	60.3	60.3	65.5
	Okay	5	10.3	10.3	75.9
	Scared	14	24.1	24.1	100.0
	Total	58	100.0	100.0	

Aggressive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	3	5.2	5.2	5.2
	Happy	10	18.9	18.9	24.1
	Okay	31	53.4	53.4	77.6
	Scared	13	22.4	22.4	100.0
	Total	58	100.0	100.0	

Very Aggressive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Angry	30	53.4	53.4	53.4
	Happy	14	24.1	24.1	77.6
	Okay	2	3.4	3.4	81.0
	Scared	11	19.0	19.0	100.0
	Total	58	100.0	100.0	

Child Pie Chart Approach Frequencies

Approached

Gender			Frequency	Percent	Valid Percent	Cumulative Percent
Male	Valid	Aggressive	4	16.0	16.0	16.0
		Distressed	4	16.0	16.0	32.0
		Friendly	7	28.0	28.0	60.0
		Neutral	2	8.0	8.0	68.0
		Very Aggressive	8	32.0	32.0	100.0
		Total	25	100.0	100.0	
Female	Valid	Aggressive	4	11.4	11.4	11.4
		Distressed	6	17.1	17.1	28.6
		Friendly	13	37.1	37.1	65.7
		Neutral	5	14.3	14.3	80.0
		Very Aggressive	7	20.0	20.0	100.0
		Total	35	100.0	100.0	

Child only two-way practical distance ANOVA

Descriptive Statistics

Dependent Variable: Distance

Age Group	Gender	Mean	Std. Deviation	N
4-6	Male	1.5909	1.28098	11
	Female	.9167	1.12479	12
	Total	1.2391	1.22353	23
7-8	Male	1.6111	1.13957	9
	Female	1.1923	.96907	13
	Total	1.3636	1.03719	22
9-10	Male	2.0000	.86603	5
	Female	2.4250	1.22503	10
	Total	2.2833	1.10545	15
Total	Male	1.6800	1.12620	25
	Female	1.4500	1.24233	35
	Total	1.5458	1.19097	60

Tests of Between-Subjects Effects

Dependent Variable: Distance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	15.196[a]	5	3.039	2.396	.049	.182
Intercept	143.127	1	143.127	112.846	.000	.676
AgeGroup	8.312	2	4.156	3.277	.045	.108
Gender	.674	1	.674	.531	.469	.010
AgeGroup * Gender	2.622	2	1.311	1.034	.363	.037
Error	68.490	54	1.268			
Total	227.063	60				
Corrected Total	83.686	59				

a. R Squared = .182 (Adjusted R Squared = .106)

Multiple Comparisons

Dependent Variable: Distance

Tukey HSD

(I) Age Group	(J) Age Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
4-5	7-8	-.1245	.33585	.927	-.9339	.6849
	9-10	-1.0442*	.37377	.019	-1.9450	-.1434
7-8	4-5	.1245	.33585	.927	-.6849	.9339
	9-10	-.9197*	.37710	.047	-1.8285	-.0109
9-10	4-5	1.0442*	.37377	.019	.1434	1.9450
	7-8	.9197*	.37710	.047	.0109	1.8285

Based on observed means.

The error term is Mean Square(Error) = 1.268.

*. The mean difference is significant at the .05 level.

Student and Adult two-way practical distance ANOVA

Descriptive Statistics

Dependent Variable: Average Distance

Gender	Age	Mean	Std. Deviation	N
Male	Student	2.6944	.63103	18
	Adult	2.6375	1.16734	8
	Total	2.6769	.80811	26
Female	Student	2.9519	.84415	27
	Adult	3.7200	1.23371	50
	Total	3.4506	1.16671	77
Total	Student	2.8489	.76889	45
	Adult	3.5707	1.27183	58
	Total	3.2553	1.13507	103

Tests of Between-Subjects Effects

Dependent Variable: SAverageDistance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	21.999[a]	3	7.333	6.635	.000	.167
Intercept	606.463	1	606.463	548.732	.000	.847
Age	2.129	1	2.129	1.926	.168	.019
Gender	7.556	1	7.556	6.837	.010	.065
Age * Gender	2.865	1	2.865	2.593	.111	.026
Error	109.416	99	1.105			
Total	1222.930	103				
Corrected Total	131.415	102				

a. R Squared = .167 (Adjusted R Squared = .142)

Independent t test for adult practical distance

Group Statistics

	Age	N	Mean	Std. Deviation	Std. Error Mean
Friendly	Student	45	2.0889	1.10417	.16460
	Adult	58	3.7414	1.28501	.16873

Independent Samples T

		Levene's Test for Equality of Variances		t-test for E						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Friendly	Equal variance assumed	2.659	.106	-6.877	101	.000	-1.65249	.24028	-2.12915	-1.17583
	Equal variance not assumed			-7.010	99.903	.000	-1.65249	.23572	-2.12015	-1.18483

Group Statistics

	Age	N	Mean	Std. Deviation	Std. Error Mean
Distressed	Student	45	2.1444	1.16591	.17380
	Adult	58	3.3621	1.49793	.19669

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Distressed	Equal variance assumed	2.613	.109	-4.496	101	.000	-1.21762	.27082	-1.75486	-.68039

	Equal variance not assumed			-4.639	100.997	.000	-1.21762	.26248	-1.73831	-.69694

Group Statistics

	Age	N	Mean	Std. Deviation	Std. Error Mean
Aggressive	Student	45	2.7222	.85650	.12768
	Adult	58	4.2241	1.10093	.14456

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Aggressive	Equal variance assumed	5.606	.020	-7.547	101	.000	-1.50192	.19901	-1.89670	-1.10713
	Equal variance not assumed			-7.787	100.997	.000	-1.50192	.19287	-1.88452	-1.11931

Age and Gender Two Way ANOVA Questionnaire Correct Human

Descriptive Statistics

Dependent Variable: Human Percent

Age Group	Gender	Mean	Std. Deviation	N
4-6	Male	75.0000	13.58893	12
	Female	78.1250	14.79020	16
	Total	76.7857	14.11522	28

7-8	Male	86.0577	12.79695	13
	Female	86.3281	10.26187	16
	Total	86.2069	11.25239	29
9-10	Male	86.8056	9.08104	9
	Female	92.7885	8.00641	13
	Total	90.3409	8.78125	22
18-22	Male	95.1389	4.57553	18
	Female	94.6759	5.11400	27
	Total	94.8611	4.85750	45
25+	Male	90.6250	5.78638	8
	Female	94.7500	6.23212	50
	Total	94.1810	6.28958	58
Total	Male	87.2917	11.84551	60
	Female	91.2398	10.08934	122
	Total	89.9382	10.82833	182

Tests of Between-Subjects Effects

Dependent Variable: HumanPercent

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7763.175[a]	9	862.575	11.023	.000	.366
Intercept	1090078.763	1	1090078.763	13930.132	.000	.988
AgeGroup	6349.804	4	1587.451	20.286	.000	.321
Gender	239.211	1	239.211	3.057	.082	.017
AgeGroup * Gender	210.598	4	52.650	.673	.612	.015
Error	13459.567	172	78.253			
Total	1493398.438	182				
Corrected Total	21222.742	181				

a. R Squared = .366 (Adjusted R Squared = .333)

Multiple Comparisons

Dependent Variable: Human Percent

Tukey HSD

(I) Age Group	(J) Age Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
4-6	7-8	-9.4212*	2.34375	.001	-15.8827	-2.9596

	9-10	-13.5552*	2.52026	.000	-20.5034	-6.6070
	18-22	-18.0754*	2.12925	.000	-23.9456	-12.2052
	25+	-17.3953*	2.03567	.000	-23.0075	-11.7831
7-8	4-6	9.4212*	2.34375	.001	2.9596	15.8827
	9-10	-4.1340	2.50107	.466	-11.0293	2.7613
	18-22	-8.6542*	2.10650	.001	-14.4617	-2.8467
	25+	-7.9741*	2.01186	.001	-13.5207	-2.4276
9-10	4-6	13.5552*	2.52026	.000	6.6070	20.5034
	7-8	4.1340	2.50107	.466	-2.7613	11.0293
	18-22	-4.5202	2.30129	.288	-10.8647	1.8243
	25+	-3.8401	2.21499	.416	-9.9467	2.2664
18-22	4-6	18.0754*	2.12925	.000	12.2052	23.9456
	7-8	8.6542*	2.10650	.001	2.8467	14.4617
	9-10	4.5202	2.30129	.288	-1.8243	10.8647
	25+	.6801	1.75732	.995	-4.1647	5.5249
25+	4-6	17.3953*	2.03567	.000	11.7831	23.0075
	7-8	7.9741*	2.01186	.001	2.4276	13.5207
	9-10	3.8401	2.21499	.416	-2.2664	9.9467
	18-22	-.6801	1.75732	.995	-5.5249	4.1647

Based on observed means.

The error term is Mean Square(Error) = 78.253.

*. The mean difference is significant at the .05 level.

Macaque

Descriptive Statistics

Dependent Variable: Macaque Percent

Age Group	Gender	Mean	Std. Deviation	N
4-6	Male	22.0833	6.55686	12
	Female	22.8125	10.48312	16
	Total	22.5000	8.87151	28
7-8	Male	26.5385	9.21607	13
	Female	24.3750	8.34166	16
	Total	25.3448	8.65314	29
9-10	Male	22.7778	10.63929	9
	Female	27.6923	5.25015	13
	Total	25.6818	8.06159	22
18-22	Male	29.4444	12.47219	18

	Female	26.4815	9.28344	27
	Total	27.6667	10.63869	45
25+	Male	30.0000	12.81740	8
	Female	28.3000	9.29176	50
	Total	28.5345	9.73367	58
Total	Male	26.4167	10.73927	60
	Female	26.5984	9.07422	122
	Total	26.5385	9.62537	182

Tests of Between-Subjects Effects

Dependent Variable: MacaquePercent

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1082.886[a]	9	120.321	1.319	.230	.065
Intercept	95462.961	1	95462.961	1046.747	.000	.859
AgeGroup	795.036	4	198.759	2.179	.073	.048
Gender	1.968	1	1.968	.022	.883	.000
AgeGroup * Gender	259.088	4	64.772	.710	.586	.016
Error	15686.345	172	91.200			
Total	144950.000	182				
Corrected Total	16769.231	181				

a. R Squared = .065 (Adjusted R Squared = .016)

Intergenerational effects

			MQ Score Parent	MP Score Parent	MP Distance Parent	HQ Score Parent
Spearman's rho	MQ Score Child	Correlation Coefficient	-.030	-.113	.074	.034
		Sig. (2-tailed)	.811	.368	.555	.787
		N	66	66	66	66
	MP Score Child	Correlation Coefficient	.080	-.134	.106	.187
		Sig. (2-tailed)	.524	.284	.396	.133
		N	66	66	66	66
	MP Distance Child	Correlation Coefficient	-.068	.126	.010	.047
		Sig. (2-tailed)	.587	.313	.935	.707
		N	66	66	66	66
	HQ Score Child	Correlation Coefficient	.132	.136	.040	.027
		Sig. (2-tailed)	.289	.277	.752	.830
		N	66	66	66	66

Wilcoxon between perceived and actual expression

Descriptive Statistics

Age Group		N	Mean	Std. Deviation	Minimum	Maximum
Adult	Perceived Scared	55	4.9133	1.33361	.75	6.00
	Perceived Okay	56	3.6230	1.56264	.00	6.00
	Perceived Angry	55	5.5495	.71198	2.33	6.00
	Actual VeryAgg	56	5.0759	1.17543	1.25	6.00
	Perceived Happy	55	3.1800	1.87931	.00	6.00
	Actual Distressed	56	4.0714	1.60377	.25	6.00
	Actual Neutral	56	4.3423	1.43955	.00	6.00
	Actual Aggressive	56	3.8318	1.54456	.00	6.00
	Actual Friendly	56	4.1532	1.65813	.25	6.00
Student	Perceived Scared	44	4.3298	1.22675	1.75	6.00
	Perceived Okay	44	4.3298	1.22675	1.75	6.00
	Perceived Angry	47	5.0954	1.02812	2.25	6.00
	Actual VeryAgg	47	4.5798	1.30124	1.50	6.00
	Perceived Happy	45	2.0908	1.36876	.00	6.00
	Actual Distressed	47	3.3298	1.25120	.50	6.00
	Actual Neutral	47	3.8989	1.23651	1.00	6.00
	Actual Aggressive	47	3.2340	1.16377	.75	6.00
	Actual Friendly	47	3.5585	1.26964	.75	6.00

Test Statistics[a]

Age Group		ActDist - PerScared	ActlNeut - PercOkay	ActAgg - PercAngry	ActVAgg - PercAngry	ActFriend - PercHappy
Adult	Z	-4.435[b]	-5.038[c]	-5.971[b]	-3.726[b]	-5.515[c]
	Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000
Student	Z	-4.806[b]	-2.582[b]	-5.752[b]	-3.903[b]	-5.502[c]
	Asymp. Sig. (2-tailed)	.000	.010	.000	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

Wilcoxon Perception of Macaques between practical and questionnaire

Split by age

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
QuesDistress	183	.0888	.17572	.00	.75
QuesNeut	183	.3839	.28560	.00	1.00
QuesAgg	183	.0505	.11650	.00	.50
QuesVAgg	183	.4344	.28793	.00	1.00
QuesFriend	183	.3784	.28087	.00	1.00
PracDistress	183	.1202	.32611	.00	1.00
PracNeut	183	.3552	.47988	.00	1.00
PracAgg	183	.0492	.21684	.00	1.00
PracVAgg	183	.4208	.49504	.00	1.00
PracFriend	183	.6940	.46210	.00	1.00

Test Statistics[a]

	PracDistress - QuesDistress	PracNeut - QuesNeut	PracAgg - QuesAgg	PracVAgg - QuesVAgg	PracFriend - QuesFriend
Z	-.826[b]	-.495[c]	-1.000[c]	-.342[c]	-7.265[b]
Asymp. Sig. (2-tailed)	.409	.620	.317	.733	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.

Descriptive Statistics

AgeGroup		N	Mean	Std. Deviation	Minimum	Maximum
Child	QuesDistress	81	.0772	.16125	.00	.75
	QuesNeut	81	.2623	.22326	.00	1.00
	QuesAgg	81	.0494	.11470	.00	.50
	QuesVAgg	81	.3704	.28535	.00	1.00
	QuesFriend	81	.4969	.25768	.00	1.00
	PracDistress	81	.0617	.24216	.00	1.00
	PracNeut	81	.2099	.40976	.00	1.00
	PracAgg	81	.0741	.26352	.00	1.00
	PracVAgg	81	.2469	.43390	.00	1.00

	PracFriend	81	.7654	.42637	.00	1.00
Student	QuesDistress	47	.0904	.17620	.00	.75
	QuesNeut	47	.4468	.29459	.00	1.00
	QuesAgg	47	.0691	.14467	.00	.50
	QuesVAgg	47	.5213	.23791	.00	1.00
	QuesFriend	47	.2660	.25219	.00	.75
	PracDistress	47	.1064	.31166	.00	1.00
	PracNeut	47	.4255	.49977	.00	1.00
	PracAgg	47	.0000	.00000	.00	.00
	PracVAgg	47	.5957	.49605	.00	1.00
	PracFriend	47	.6596	.47898	.00	1.00
Adult	QuesDistress	55	.1045	.19656	.00	.75
	QuesNeut	55	.5091	.29251	.00	1.00
	QuesAgg	55	.0364	.08895	.00	.25
	QuesVAgg	55	.4545	.31214	.00	1.00
	QuesFriend	55	.3000	.27386	.00	1.00
	PracDistress	55	.2182	.41682	.00	1.00
	PracNeut	55	.5091	.50452	.00	1.00
	PracAgg	55	.0545	.22918	.00	1.00
	PracVAgg	55	.5273	.50386	.00	1.00
	PracFriend	55	.6182	.49031	.00	1.00

Test Statistics[a]

AgeGroup		PracDistress - QuesDistress	PracNeut - QuesNeut	PracAgg - QuesAgg	PracVAgg - QuesVAgg	PracFriend - QuesFriend
Child	Z	-.891[b]	-1.132[b]	-.314[c]	-2.239[b]	-4.411[c]
	Asymp. Sig. (2-tailed)	.373	.258	.754	.025	.000
Student	Z	-.100[b]	-.228[b]	-2.919[b]	-.929[c]	-4.225[c]
	Asymp. Sig. (2-tailed)	.921	.819	.004	.353	.000
Adult	Z	-1.989[c]	-.115[c]	-.053[b]	-.919[c]	-3.995[c]
	Asymp. Sig. (2-tailed)	.047	.908	.958	.358	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

Split by Gender

Descriptive Statistics

Gender		N	Mean	Std. Deviation	Minimum	Maximum
Male	QuesDistress	62	.0968	.17738	.00	.75
	QuesNeut	62	.3508	.29497	.00	1.00
	QuesAgg	62	.0685	.12939	.00	.50
	QuesVAgg	62	.4355	.32307	.00	1.00
	QuesFriend	62	.4113	.28305	.00	1.00
	Questionnaire	62	.2726	.11547	.10	.55
	PracDistress	62	.0968	.29806	.00	1.00
	PracNeut	62	.2742	.44975	.00	1.00
	PracAgg	62	.0645	.24768	.00	1.00
	PracVAgg	62	.4194	.49748	.00	1.00
	PracFriend	62	.7097	.45762	.00	1.00
	Practical	62	.3129	.17969	.00	.60
Female	QuesDistress	121	.0847	.17546	.00	.75
	QuesNeut	121	.4008	.28040	.00	1.00
	QuesAgg	121	.0413	.10872	.00	.50
	QuesVAgg	121	.4339	.26958	.00	1.00
	QuesFriend	121	.3616	.27942	.00	1.00
	Questionnaire	121	.2645	.08954	.05	.50
	PracDistress	121	.1322	.34015	.00	1.00
	PracNeut	121	.3967	.49125	.00	1.00
	PracAgg	121	.0413	.19986	.00	1.00
	PracVAgg	121	.4215	.49585	.00	1.00
	PracFriend	121	.6860	.46607	.00	1.00
	Practical	121	.3355	.20851	.00	.80

Wilcoxon behaviour towards Macaques between practical and questionnaire

Split by age

Test Statistics[a]

Gender		PDistress - QDistress	PNeut - QNeut	PAgg - QAgg	PVAgg - QVAgg	PFriend - QFriend	P - Q
Male	Z	-.383[b]	-1.388[b]	-.880[b]	-.327[b]	-4.065[c]	-1.963[c]
	Asymp. Sig. (2-tailed)	.701	.165	.379	.744	.000	.050
Female	Z	-1.196[c]	-.238[c]	-.618[b]	-.183[b]	-6.061[c]	-3.448[c]
	Asymp. Sig. (2-tailed)	.232	.812	.537	.855	.000	.001

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks.
c. Based on negative ranks.

Descriptive Statistics

Age		N	Mean	Std. Deviation	Minimum	Maximum
Adult	FriendlyQ	57	3.7822	1.39548	.25	5.00
	NeutralQ	57	3.9123	1.22519	.00	5.00
	DistressedQ	57	3.6696	1.36013	.25	5.00
	AggressiveQ	57	3.5307	1.32883	.00	5.00
	VeryAggressiveQ	57	4.4518	.88696	1.25	5.00
	AverageQ	57	3.8693	1.10541	.40	5.00
	FriendlyP	57	3.2105	1.65278	.00	5.00
	NeutralP	57	3.6579	1.34681	.00	5.00
	DistressedP	57	3.3421	1.58158	.00	5.00
	AggressiveP	57	3.3596	1.50521	.00	5.00
	VeryAggressiveP	57	4.2193	1.11009	1.00	5.00
	AverageP	57	3.5579	1.26448	.20	5.00
Student	FriendlyQ	43	3.3605	.98546	1.50	5.00
	NeutralQ	43	3.7907	.91276	2.00	5.00
	DistressedQ	43	3.0581	1.00865	1.00	5.00
	AggressiveQ	43	3.2209	.90831	1.50	5.00

	VeryAggressiveQ	43	4.0988	.95764	1.75	5.00
	AverageQ	43	3.5090	.77064	1.85	5.00
	FriendlyP	43	2.0465	1.09007	.50	5.00
	NeutralP	43	3.5000	1.05221	1.00	5.00
	DistressedP	43	2.0930	1.13524	.00	5.00
	AggressiveP	43	2.7558	.83361	1.00	5.00
	VeryAggressiveP	43	3.8837	1.12777	2.00	5.00
	AverageP	43	2.8558	.76136	1.50	5.00

Test Statistics[a]

Age		FriendlyP - FriendlyQ	NeutralP - NeutralQ	DistressP - DistressQ	AggressP - AggressQ	VeryAggP - VeryAggQ	AverageP - AverageQ
Adult	Z	-3.270[b]	-1.982[b]	-2.335[b]	-1.097[b]	-2.177[b]	-2.721[b]
	Asymp. Sig. (2-tailed)	.001	.048	.020	.272	.029	.007
Student	Z	-5.341[b]	-1.550[b]	-4.776[b]	-3.233[b]	-1.228[b]	-4.576[b]
	Asymp. Sig. (2-tailed)	.000	.121	.000	.001	.219	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Split by gender

Descriptive Statistics

Gender		N	Mean	Std. Deviation	Minimum	Maximum
Male	FriendlyQ	26	3.2981	1.09092	1.25	5.00
	NeutralQ	26	3.4519	1.22069	.25	5.00
	DistressedQ	26	3.0385	1.09702	.75	5.00
	AggressiveQ	26	2.8942	1.05635	.75	5.00
	VeryAggressiveQ	26	4.0577	1.11200	1.25	5.00
	AverageQ	26	3.3481	.92060	.85	5.00
	FriendlyP	26	2.0962	1.38578	.00	5.00
	NeutralP	26	3.2500	1.29808	1.00	5.00
	DistressedP	26	2.2885	1.37239	.00	5.00
	AggressiveP	26	2.6346	1.20464	.00	5.00
	VeryAggressiveP	26	3.9038	1.09562	1.50	5.00

	AverageP	26	2.8346	.92258	.60	5.00
Female	FriendlyQ	74	3.7072	1.28877	.25	5.00
	NeutralQ	74	4.0034	1.02243	.00	5.00
	DistressedQ	74	3.5361	1.28547	.25	5.00
	AggressiveQ	74	3.5743	1.16508	.00	5.00
	VeryAggressiveQ	74	4.3851	.84924	1.50	5.00
	AverageQ	74	3.8431	.98378	.40	5.00
	FriendlyP	74	2.9257	1.54761	.00	5.00
	NeutralP	74	3.7095	1.18497	.00	5.00
	DistressedP	74	2.9865	1.55267	.00	5.00
	AggressiveP	74	3.2635	1.28805	.00	5.00
	VeryAggressiveP	74	4.1351	1.13565	1.00	5.00
	AverageP	74	3.4041	1.16130	.20	5.00

Test Statistics[a]

Gender		FriendlyP - FriendlyQ	NeutralP - NeutralQ	DistressedP - DistressedQ	AggressiveP - AggressiveQ	VeryAggressiveP - VeryAggressiveQ	AverageP - AverageQ
Male	Z	-3.868[b]	-1.126[b]	-3.208[b]	-1.234[b]	-.778[b]	-3.365[b]
	Asymp. Sig. (2-tailed)	.000	.260	.001	.217	.437	.001
Female	Z	-4.934[b]	-2.410[b]	-3.953[b]	-2.660[b]	-2.286[b]	-4.148[b]
	Asymp. Sig. (2-tailed)	.000	.016	.000	.008	.022	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Appendix G2. SPSS Output

Participant Demographics

Gender

Group			Frequency	Percent	Valid Percent	Cumulative Percent
UK	Valid	Male	11	19.6	19.6	19.
		Female	45	80.4	80.4	100.
		Total	56	100.0	100.0	
ARG Novice	Valid	Male	9	23.7	23.7	23.
		Female	29	76.3	76.3	100.
		Total	38	100.0	100.0	
ARG Exp	Valid	Male	3	17.6	17.6	17.
		Female	14	82.4	82.4	100.
		Total	17	100.0	100.0	

Descriptive Statistics

Group		N	Minimum	Maximum	Mean	Std. Dev
UK	Age	56	22.00	81.00	43.5000	17
	Valid N (listwise)	56				
ARG Novice	Age	38	22.00	67.00	37.8684	11
	Valid N (listwise)	38				
ARG Exp	Age	17	24.00	43.00	35.0588	6
	Valid N (listwise)	17				

Confusion Matrix 1

Neutral

Group			Frequency	Percent	Valid Percent	Cumulat Percer
UK	Valid	Angry (Aggressive)	8	1.8	1.8	
		Happy (Friendly)	22	4.9	4.9	
		Okay (Neutral)	344	76.8	76.8	
		Scared (Distressed)	74	16.5	16.5	
		Total	448	100.0	100.0	
ARG EXP	Valid	Angry (Aggressive)	5	3.7	3.7	
		Happy (Friendly)	6	4.4	4.4	
		Okay (Neutral)	115	84.6	84.6	
		Scared (Distressed)	10	7.4	7.4	
		Total	136	100.0	100.0	
ARG NOVICE	Valid	Angry (Aggressive)	6	2.0	2.0	

		Happy (Friendly)	7	2.3	2.3	
		Okay (Neutral)	231	76.0	76.0	
		Scared (Distressed)	60	19.7	19.7	
		Total	304	100.0	100.0	

Distressed

Group			Frequency	Percent	Valid Percent	Cumulative Percent
UK	Valid	Angry (Aggressive)	64	14.3	14.3	14.3
		Happy (Friendly)	144	32.1	32.1	46.4
		Okay (Neutral)	81	18.1	18.1	64.5
		Scared (Distressed)	159	35.5	35.5	100.0
		Total	448	100.0	100.0	
ARG EXP	Valid	Angry (Aggressive)	24	17.6	17.6	17.6
		Happy (Friendly)	30	22.1	22.1	39.7
		Okay (Neutral)	11	8.1	8.1	47.8
		Scared (Distressed)	71	52.2	52.2	100.0
		Total	136	100.0	100.0	
ARG NOVICE	Valid	Angry (Aggressive)	30	9.9	9.9	9.9
		Happy (Friendly)	123	40.5	40.5	50.3
		Okay (Neutral)	32	10.5	10.5	60.9
		Scared (Distressed)	119	39.1	39.1	100.0
		Total	304	100.0	100.0	

Aggressive

Group			Frequency	Percent	Valid Percent	Cumulative Percent
UK	Valid	Angry (Aggressive)	219	48.9	48.9	48.9
		Happy (Friendly)	50	11.2	11.2	60.0
		Okay (Neutral)	68	15.2	15.2	75.2
		Scared (Distressed)	111	24.8	24.8	100.0
		Total	448	100.0	100.0	
ARG EXP	Valid	Angry (Aggressive)	91	66.9	66.9	66.9
		Happy (Friendly)	11	8.1	8.1	75.0
		Okay (Neutral)	1	.7	.7	75.7
		Scared (Distressed)	33	24.3	24.3	100.0
		Total	136	100.0	100.0	

ARG NOVICE	Valid	Angry (Aggressive)	173	56.9	56.9	56.
		Happy (Friendly)	46	15.1	15.1	72.
		Okay (Neutral)	13	4.3	4.3	76.
		Scared (Distressed)	72	23.7	23.7	100.
		Total	304	100.0	100.0	

Score - Two-way ANOVA for gender and country

Descriptive Statistics

Dependent Variable: Score

Gender	Country	Mean	Std. Deviation	N
Male	UK	62.5000	12.77476	11
	ARG	56.9444	16.00239	9
	Total	60.0000	14.20403	20
Female	UK	51.5741	12.69696	45
	ARG	57.4713	12.36932	29
	Total	53.8851	12.81623	74
Total	UK	53.7202	13.33519	56
	ARG	57.3465	13.08447	38
	Total	55.1862	13.28461	94

Tests of Between-Subjects Effects

Dependent Variable: Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1354.791[a]	3	451.597	2.699	.050	.083
Intercept	201787.782	1	201787.782	1206.069	.000	.931
Country	.451	1	.451	.003	.959	.000
Gender	417.978	1	417.978	2.498	.117	.027
Country * Gender	506.968	1	506.968	3.030	.085	.033
Error	15057.924	90	167.310			
Total	302690.972	94				
Corrected Total	16412.714	93				

a. R Squared = .083 (Adjusted R Squared = .052)

Score - One-way ANOVA for each expression

Descriptives

ExpScore

Expression		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Neutral	UK	56	76.7857	19.86153	2.65411	71.4668	82.1047
	ARG	38	75.9868	14.64143	2.37515	71.1743	80.7994
	Total	94	76.4628	17.85323	1.84142	72.8061	80.1195
Distressed	UK	56	35.4911	23.92897	3.19764	29.0829	41.8993
	ARG	38	39.1447	26.50393	4.29950	30.4331	47.8564
	Total	94	36.9681	24.92697	2.57102	31.8625	42.0736
Aggressive	UK	56	48.8839	19.11044	2.55374	43.7661	54.0017
	ARG	38	56.9079	18.76629	3.04429	50.7396	63.0762
	Total	94	52.1277	19.28130	1.98871	48.1785	56.0769

ANOVA

ExpScore

Expression		Sum of Squares	df	Mean Square	F	Sig.
Neutral	Between Groups	14.448	1	14.448	.045	.833
	Within Groups	29628.172	92	322.045		
	Total	29642.620	93			
Distressed	Between Groups	302.205	1	302.205	.484	.489
	Within Groups	57483.699	92	624.823		
	Total	57785.904	93			
Aggressive	Between Groups	1457.545	1	1457.545	4.049	.047
	Within Groups	33116.923	92	359.967		
	Total	34574.468	93			

Tests of Between-Subjects Effects

Dependent Variable: ExpScore

Expression	Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squar
Neutral	Corrected Model	.092[a]	1	.092	.045	.833	
	Intercept	3381.539	1	3381.539	1640.656	.000	
	Country	.092	1	.092	.045	.833	
	Error	189.620	92	2.061			

	Total	3707.000	94				
	Corrected Total	189.713	93				
Distressed	Corrected Model	1.934[b]	1	1.934	.484	.489	
	Intercept	807.083	1	807.083	201.828	.000	
	Country	1.934	1	1.934	.484	.489	
	Error	367.896	92	3.999			
	Total	1192.000	94				
	Corrected Total	369.830	93				
Aggressive	Corrected Model	9.328[c]	1	9.328	4.049	.047	
	Intercept	1621.541	1	1621.541	703.859	.000	
	Country	9.328	1	9.328	4.049	.047	
	Error	211.948	92	2.304			
	Total	1856.000	94				
	Corrected Total	221.277	93				

a. R Squared = .000 (Adjusted R Squared = -.010)
b. R Squared = .005 (Adjusted R Squared = -.006)
c. R Squared = .042 (Adjusted R Squared = .032)

Distance – Two-way ANOVA between country and gender

Tests of Between-Subjects Effects

Dependent Variable: Approach2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	154.748[a]	3	51.583	7.007	.000
Intercept	2908.286	1	2908.286	395.062	.000
Gender	104.754	1	104.754	14.230	.000
Country	19.559	1	19.559	2.657	.107
Gender * Country	1.302	1	1.302	.177	.675
Error	662.544	90	7.362		
Total	6440.843	94			
Corrected Total	817.291	93			

Descriptive Statistics

Tests of Between-Subjects Effects

Dependent Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	154.757[a]	3	51.586	7.007	.000	.189
Intercept	2908.164	1	2908.164	395.022	.000	.814
Gender	104.731	1	104.731	14.226	.000	.136
Country	19.569	1	19.569	2.658	.107	.029
Gender * Country	1.304	1	1.304	.177	.675	.002
Error	662.583	90	7.362			
Total	6440.634	94				
Corrected Total	817.340	93				

a. R Squared = .189 (Adjusted R Squared = .162)

Dependent Variable: Approach2

Gender	Country	Mean	Std. Deviation	N
Male	UK	5.9735	2.85921	11
	ARG	5.1389	2.47877	9
	Total	5.5979	2.65918	20
Female	UK	8.8667	2.58229	45
	ARG	7.4517	2.91693	29
	Total	8.3122	2.78682	74
Total	UK	8.2984	2.85766	56
	ARG	6.9039	2.95978	38
	Total	7.7347	2.96447	94

Spearman's rank-order correlation between age and distance

Correlations

	Age	Approach2

Age	Pearson Correlation	1	.341**
	Sig. (2-tailed)		.001
	N	94	94
Approach2	Pearson Correlation	.341**	1
	Sig. (2-tailed)	.001	
	N	94	94

**. Correlation is significant at the 0.01 level (2-tailed).

Approach – One-way ANOVAs per expression

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Neutral	Between Groups	58.379	1	58.379	4.979	.028
	Within Groups	1078.793	92	11.726		
	Total	1137.172	93			
Distressed	Between Groups	58.131	1	58.131	5.378	.023
	Within Groups	994.383	92	10.809		
	Total	1052.514	93			
Aggressive	Between Groups	21.577	1	21.577	3.375	.069
	Within Groups	588.204	92	6.394		
	Total	609.781	93			

Tests of Between-Subjects Effects

Dependent Variable: Distance

Exprression	Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partia Squa
Neutral	Corrected Model	58.379[a]	1	58.379	4.979	.028	
	Intercept	4026.265	1	4026.265	343.362	.000	
	Country	58.379	1	58.379	4.979	.028	
	Error	1078.793	92	11.726			
	Total	5511.656	94				
	Corrected Total	1137.172	93				
Distressed	Corrected Model	58.131[b]	1	58.131	5.378	.023	
	Intercept	4892.660	1	4892.660	452.667	.000	
	Country	58.131	1	58.131	5.378	.023	
	Error	994.383	92	10.809			
	Total	6345.641	94				
	Corrected Total	1052.514	93				
Aggressive	Corrected Model	21.577[c]	1	21.577	3.375	.069	
	Intercept	6987.260	1	6987.260	1092.866	.000	
	Country	21.577	1	21.577	3.375	.069	
	Error	588.204	92	6.394			
	Total	8018.188	94				
	Corrected Total	609.781	93				

a. R Squared = .051 (Adjusted R Squared = .041)

Descriptive Statistics

Dependent Variable: Distance

Exprression	Country	Mean	Std. Deviation	N
Neutral	UK	7.4710	3.38731	56
	Argentina	5.8651	3.47862	38
	Total	6.8218	3.49681	94
Distressed	UK	8.1518	3.12620	56
	Argentina	6.5493	3.51391	38
	Total	7.5040	3.36413	94
Aggressive	UK	9.2723	2.51790	56
	Argentina	8.2961	2.54427	38

Total	8.8777	2.56062	94

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maxim
Neutral	UK	56	7.4710	3.38731	.45265	6.5639	8.3781	.00	11
	Arg	38	5.8651	3.47862	.56431	4.7217	7.0085	.00	11
	Total	94	6.8218	3.49681	.36067	6.1056	7.5380	.00	11
Distressed	UK	56	8.1518	3.12620	.41776	7.3146	8.9890	.00	11
	Arg	38	6.5493	3.51391	.57003	5.3943	7.7043	.00	11
	Total	94	7.5040	3.36413	.34698	6.8149	8.1930	.00	11
Aggressive	UK	56	9.2723	2.51790	.33647	8.5980	9.9466	.38	11
	Arg	38	8.2961	2.54427	.41274	7.4598	9.1323	1.00	11
	Total	94	8.8777	2.56062	.26411	8.3532	9.4021	.38	11

b. R Squared = .055 (Adjusted R Squared = .045)

c. R Squared = .035 (Adjusted R Squared = .025)

Face vs Body Confusion Matrix

NeutralFace

Group			Frequency	Percent	Valid Percent	Cumulati Percent
UK	Valid	Angry (Aggressive)	3	1.8	1.8	
		Happy (Friendly)	4	2.4	2.4	
		Okay (Neutral)	126	75.0	75.0	
		Scared (Distressed)	35	20.8	20.8	1
		Total	168	100.0	100.0	
ARG EXP	Valid	Angry (Aggressive)	3	5.9	5.9	
		Happy (Friendly)	1	2.0	2.0	

		Okay (Neutral)	41	80.4	80.4	
		Scared (Distressed)	6	11.8	11.8	1
		Total	51	100.0	100.0	
ARG NOVICE	Valid	Angry (Aggressive)	2	1.8	1.8	
		Happy (Friendly)	1	.9	.9	
		Okay (Neutral)	83	72.8	72.8	
		Scared (Distressed)	28	24.6	24.6	1
		Total	114	100.0	100.0	

DistressedFace

Group			Frequency	Percent	Valid Percent	Cumulati Percent
UK	Valid	Angry (Aggressive)	23	13.7	13.7	
		Happy (Friendly)	72	42.9	42.9	
		Okay (Neutral)	28	16.7	16.7	
		Scared (Distressed)	45	26.8	26.8	1
		Total	168	100.0	100.0	
ARG EXP	Valid	Angry (Aggressive)	12	23.5	23.5	
		Happy (Friendly)	15	29.4	29.4	
		Okay (Neutral)	5	9.8	9.8	
		Scared (Distressed)	19	37.3	37.3	1
		Total	51	100.0	100.0	
ARG NOVICE	Valid	Angry (Aggressive)	15	13.2	13.2	
		Happy (Friendly)	52	45.6	45.6	
		Okay (Neutral)	13	11.4	11.4	
		Scared (Distressed)	34	29.8	29.8	1
		Total	114	100.0	100.0	

AggressiveFace

Group			Frequency	Percent	Valid Percent	Cumulat Percer
UK	Valid	Angry (Aggressive)	63	37.5	37.5	
		Happy (Friendly)	22	13.1	13.1	
		Okay (Neutral)	33	19.6	19.6	
		Scared (Distressed)	50	29.8	29.8	

		Total	168	100.0	100.0	
ARG EXP	Valid	Angry (Aggressive)	32	62.7	62.7	
		Happy (Friendly)	2	3.9	3.9	
		Okay (Neutral)	1	2.0	2.0	
		Scared (Distressed)	16	31.4	31.4	
		Total	51	100.0	100.0	
ARG NOVICE	Valid	Angry (Aggressive)	64	56.1	56.1	
		Happy (Friendly)	18	15.8	15.8	
		Okay (Neutral)	5	4.4	4.4	
		Scared (Distressed)	27	23.7	23.7	
		Total	114	100.0	100.0	

NeutralBody

Group			Frequency	Percent	Valid Percent	Cumulativ Percent
UK	Valid	Angry (Aggressive)	3	1.8	1.8	
		Happy (Friendly)	11	6.5	6.5	
		Okay (Neutral)	123	73.2	73.2	
		Scared (Distressed)	31	18.5	18.5	1
		Total	168	100.0	100.0	
ARG EXP	Valid	Angry (Aggressive)	2	3.9	3.9	
		Happy (Friendly)	4	7.8	7.8	
		Okay (Neutral)	41	80.4	80.4	
		Scared (Distressed)	4	7.8	7.8	1
		Total	51	100.0	100.0	
ARG NOVICE	Valid	Happy (Friendly)	5	4.4	4.4	
		Okay (Neutral)	85	74.6	74.6	
		Scared (Distressed)	24	21.1	21.1	1
		Total	114	100.0	100.0	

DistressedBody

Group	Frequency	Percent	Valid Percent	Cumulative Percent

UK	Valid	Angry (Aggressive)	21	12.5	12.5	12.
		Happy (Friendly)	54	32.1	32.1	44.
		Okay (Neutral)	40	23.8	23.8	68.
		Scared (Distressed)	53	31.5	31.5	100.
		Total	168	100.0	100.0	
ARG EXP	Valid	Angry (Aggressive)	7	13.7	13.7	13.
		Happy (Friendly)	8	15.7	15.7	29.
		Okay (Neutral)	3	5.9	5.9	35.
		Scared (Distressed)	33	64.7	64.7	100.
		Total	51	100.0	100.0	
ARG NOVICE	Valid	Angry (Aggressive)	9	7.9	7.9	7.
		Happy (Friendly)	56	49.1	49.1	57.
		Okay (Neutral)	12	10.5	10.5	67.
		Scared (Distressed)	37	32.5	32.5	100.
		Total	114	100.0	100.0	

AggressiveBody

Group			Frequency	Percent	Valid Percent	Cumulative Percent
UK	Valid	Angry (Aggressive)	117	69.6	69.6	6
		Happy (Friendly)	4	2.4	2.4	7
		Okay (Neutral)	18	10.7	10.7	8
		Scared (Distressed)	29	17.3	17.3	10
		Total	168	100.0	100.0	
ARG EXP	Valid	Angry (Aggressive)	39	76.5	76.5	7
		Happy (Friendly)	5	9.8	9.8	8
		Scared (Distressed)	7	13.7	13.7	10
		Total	51	100.0	100.0	
ARG NOVICE	Valid	Angry (Aggressive)	77	67.5	67.5	6
		Happy (Friendly)	9	7.9	7.9	7
		Okay (Neutral)	5	4.4	4.4	7
		Scared (Distressed)	23	20.2	20.2	10
		Total	114	100.0	100.0	

Wilcoxon Signed Ranks – Face vs Body perception

Descriptive Statistics

Group		N	Mean	Std. Deviation	Minimum	Maximum
UK	AverageFace	56	46.4285	18.48476	.00	100.00
	AverageBody	56	58.1355	16.81655	22.22	88.89
ARG Novice	AverageFace	38	52.9245	15.80590	22.22	88.89
	AverageBody	38	58.1882	19.05950	22.22	100.00
ARG Exp	AverageFace	17	60.1312	19.26946	22.22	88.89
	AverageBody	17	73.8571	17.54308	33.33	88.89

Test Statistics[a]

Group		AverageBody - AverageFace
UK	Z	-4.270[b]
	Asymp. Sig. (2-tailed)	.000
ARG Novice	Z	-2.031[b]
	Asymp. Sig. (2-tailed)	.042
ARG Exp	Z	-2.201[b]
	Asymp. Sig. (2-tailed)	.028

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Descriptive Statistics

Country		N	Mean	Std. Deviation	Minimum	Maximu
UK	NeutralFace	56	75.0000	26.40018	.00	10
	DistressedFace	56	26.7857	28.01128	.00	10
	AggressiveFace	56	37.5000	27.75251	.00	10
	FaceAverage	56	46.4285	18.48476	.00	10
	NeutralBody	56	73.2143	27.28054	.00	10

	DistressedBody	56	31.5476	29.41836	.00	10
	AggressiveBody	56	69.6429	24.84439	.00	10
	BodyAverage	56	58.1355	16.81655	22.22	8

Test Statistics[a]

Country		NeutralBody - NeutralFace	DistressedBody - DistressedFace	AggressiveBody - AggressiveFace	BodyAverage - FaceAverage
UK	Z	-.623[b]	-1.544[c]	-5.053[c]	-4.270[c]
	Asymp. Sig. (2-tailed)	.533	.122	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

Descriptive Statistics

Experience		N	Mean	Std. Deviation	Minimum	Maxim
Arg Novice	NeutralFace	38	72.8070	21.72067	33.33	1
	DistressedFace	38	29.8246	29.80364	.00	1
	AggressiveFace	38	56.1404	24.63580	.00	1
	FaceAverage	38	52.9245	15.80590	22.22	
	NeutralBody	38	74.5614	25.03356	.00	1
	DistressedBody	38	32.4561	35.07764	.00	1
	AggressiveBody	38	67.5439	21.20519	.00	1
	BodyAverage	38	58.1882	19.05950	22.22	1
Arg Experience	NeutralFace	17	80.3922	26.50687	33.33	1
	DistressedFace	17	37.2549	28.58310	.00	
	AggressiveFace	17	62.7451	23.22102	33.33	1
	FaceAverage	17	60.1312	19.26946	22.22	
	NeutralBody	17	80.3922	26.50687	33.33	1
	DistressedBody	17	64.7059	29.97821	.00	1
	AggressiveBody	17	76.4706	25.72479	.00	1
	BodyAverage	17	73.8571	17.54308	33.33	

Test Statistics[a]

Experience		NeutralBody - NeutralFace	DistressBody - DistressFace	AggresBody - AggressFace	BodyAverag FaceAverag
No	Z	-.090[b]	-.841[b]	-3.055[b]	-2.0
	Asymp. Sig. (2-tailed)	.929	.400	.002	.
Yes	Z	-.137[b]	-2.809[b]	-1.570[b]	-2.2
	Asymp. Sig. (2-tailed)	.891	.005	.116	.

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Distance – Wilcoxon Signed Ranks - Face vs Body

Descriptive Statistics

Group		N	Mean	Std. Deviation	Minimum	Maximum
UK	AverageFace	56	6.5618	2.16052	.50	8.6
	NeutralFace	56	7.2798	3.54183	.00	11.0
	DistressedFace	56	7.6548	3.53908	.00	11.0
	AggressiveFace	56	9.0595	2.71629	.00	11.0
	AverageBody	56	8.5655	2.81149	.33	11.0
	NeutralBody	56	7.5357	3.55941	.00	11.0
	DistressedBody	56	8.3869	3.15382	.00	11.0
	AggressiveBody	56	9.7738	2.38862	1.00	11.0
Argentina	AverageFace	38	6.7573	3.00537	.44	11.0
	NeutralFace	38	6.1404	3.72689	.00	11.0
	DistressedFace	38	6.4386	3.45030	.00	11.0
	AggressiveFace	38	6.2895	3.37801	.00	11.0
	AverageBody	38	7.1667	2.89232	.22	11.0
	NeutralBody	38	6.1140	3.53556	.00	11.0
	DistressedBody	38	6.8684	3.69281	.00	11.0
	AggressiveBody	38	9.1491	2.30771	.67	11.0
Expert	AverageFace	17	8.0000	2.59986	2.33	11.0
	NeutralFace	17	6.7059	3.61686	.67	11.0
	DistressedFace	17	7.9608	2.74085	2.67	11.0
	AggressiveFace	17	7.3333	3.01904	1.67	11.0
	AverageBody	17	8.3922	2.39248	3.78	11.0

	NeutralBody	17	6.8431	3.54165	2.00	11.0
	DistressedBody	17	8.5686	2.56787	3.33	11.0
	AggressiveBody	17	9.7647	2.05063	5.00	11.0

Test Statistics[a]

Group		AverageBody - AverageFace	NeutralBody - NeutralFace	DistressedBody - DistressedFace	AggressiveB - AggressiveF
UK	Z	-6.499[b]	-.392[b]	-2.870[b]	-3.6
	Asymp. Sig. (2-tailed)	.000	.695	.004	.
Argentina	Z	-2.556[b]	-.343[b]	-1.859[b]	-4.8
	Asymp. Sig. (2-tailed)	.011	.731	.063	.
Expert	Z	-1.574[b]	-.306[b]	-1.332[b]	-2.9
	Asymp. Sig. (2-tailed)	.115	.760	.183	.

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Appendix H1. R data

HumanGLMM

R Markdown

```
library("readxl")
library("car")
library("lme4")
library("languageR")
HumanData <- read.csv("../project/HumanGLMMQ.csv")
head(HumanData)
##   ID Expression    Image Species Correct  Age Gender
## 1 98     Scared  Scared1   Human       1  5-6 Female
## 2 98     Scared  Scared2   Human       0  5-6 Female
## 3 98     Scared  Scared3   Human       0  5-6 Female
## 4 98     Scared  Scared4   Human       0  5-6 Female
## 5 98    Neutral Neutral1   Human       1  5-6 Female
## 6 98    Neutral Neutral2   Human       1  5-6 Female
HumanData$Expression=relevel(HumanData$Expression,"Happy")
FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID)
, data = HumanData,family = "binomial")
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: HumanData
```

```
##
##      AIC      BIC   logLik deviance df.resid
##   1631.9   1703.6   -803.9   1607.9     2900
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -10.5639   0.1202   0.2155   0.3333   1.3364
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3284   0.5731
##  Image  (Intercept) 0.5747   0.7581
## Number of obs: 2912, groups:  ID, 180; Image, 16
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)         2.7364     0.4661   5.870 4.35e-09 ***
## ExpressionAngry    -1.2853     0.6009  -2.139 0.032429 *
## ExpressionNeutral  -1.9401     0.5888  -3.295 0.000984 ***
## ExpressionScared   -1.1579     0.5955  -1.944 0.051844 .
## Age 7-8             0.8004     0.2411   3.320 0.000899 ***
## Age 9-10            1.2291     0.2793   4.400 1.08e-05 ***
## Age18-22            1.9486     0.2535   7.686 1.52e-14 ***
## Age23-40            1.8461     0.2669   6.918 4.58e-12 ***
## Age41-60            1.5523     0.3268   4.749 2.04e-06 ***
## GenderMale         -0.2836     0.1725  -1.644 0.100224
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsA ExprsN ExprsS Age7-8 Ag9-10 A18-22 A23-40
A41-60
## ExprssnAngr -
0.676
## ExprssnNtrl -
0.691  0.538
## ExprssnScrd -
0.684  0.532  0.543
## Age 7-8     -0.213 -0.009 -0.016 -
0.008
## Age 9-10    -0.183 -0.011 -0.017 -
0.009  0.402
## Age18-22    -0.199 -0.015 -0.024 -
0.012  0.446  0.394
## Age23-40    -0.221 -0.014 -0.022 -
0.011  0.429  0.376  0.421
## Age41-60    -0.171 -0.010 -0.016 -
0.008  0.344  0.303  0.338  0.342
## GenderMale  -0.172  0.003  0.005  0.003  0.003 -
0.010  0.004  0.203  0.090
HumanData$Expression=relevel(HumanData$Expression,"Neutral")
FullGLMM
<- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID), data
= HumanData,family = "binomial")
```

```
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: HumanData
##
##      AIC      BIC   logLik deviance df.resid
##   1631.9   1703.6   -803.9   1607.9     2900
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -10.5636   0.1202   0.2155   0.3333   1.3364
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3284   0.5731
##  Image  (Intercept) 0.5747   0.7581
## Number of obs: 2912, groups:  ID, 180; Image, 16
##
## Fixed effects:
##                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)        0.7964     0.4298   1.853 0.063885 .
## ExpressionHappy    1.9398     0.5891   3.293 0.000993 ***
## ExpressionAngry    0.6547     0.5722   1.144 0.252612
## ExpressionScared   0.7821     0.5662   1.381 0.167133
## Age 7-8            0.8003     0.2411   3.319 0.000902 ***
## Age 9-10           1.2291     0.2794   4.400 1.08e-05 ***
## Age18-22           1.9486     0.2536   7.685 1.53e-14 ***
## Age23-40           1.8461     0.2669   6.917 4.62e-12 ***
## Age41-60           1.5521     0.3269   4.748 2.05e-06 ***
## GenderMale        -0.2836     0.1725  -1.644 0.100232
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsH ExprsA ExprsS Age7-8 Ag9-10 A18-22 A23-40
A41-60
## ExprssnHppy -
0.621
## ExprssnAngr -
0.635  0.464
## ExprssnScrd -
0.643  0.469  0.483
## Age 7-8     -
0.253  0.016  0.006  0.008
## Age 9-10    -
0.222  0.017  0.007  0.009  0.402
## Age18-22    -
0.248  0.024  0.009  0.012  0.446  0.394
## Age23-40    -
0.270  0.022  0.008  0.012  0.429  0.376  0.421
## Age41-60    -
0.208  0.016  0.006  0.008  0.344  0.303  0.338  0.342
```

```
## GenderMale  -0.179 -0.005 -0.002 -0.003  0.003 -
0.010  0.004  0.203  0.090
HumanData$Expression=relevel(HumanData$Expression,"Scared")
FullGLMM
<- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID), data
= HumanData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
control$checkConv, :
## Model failed to converge with max|grad| = 0.00250933 (tol = 0.002,
component 1)
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: HumanData
##
##      AIC      BIC   logLik deviance df.resid
##   1631.9   1703.6   -803.9   1607.9     2900
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -10.5644   0.1202   0.2155   0.3333   1.3365
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3285   0.5731
##  Image  (Intercept) 0.5748   0.7581
## Number of obs: 2912, groups:  ID, 180; Image, 16
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)         1.5784     0.4387   3.598 0.000320 ***
## ExpressionNeutral  -0.7820     0.5662  -1.381 0.167235
## ExpressionHappy     1.1581     0.5960   1.943 0.051993 .
## ExpressionAngry    -0.1270     0.5787  -0.220 0.826258
## Age 7-8             0.8005     0.2411   3.320 0.000901 ***
## Age 9-10            1.2292     0.2794   4.400 1.08e-05 ***
## Age18-22            1.9487     0.2536   7.685 1.54e-14 ***
## Age23-40            1.8463     0.2669   6.917 4.61e-12 ***
## Age41-60            1.5518     0.3269   4.747 2.06e-06 ***
## GenderMale         -0.2836     0.1725  -1.644 0.100272
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsN ExprsH ExprsA Age7-8 Ag9-10 A18-22 A23-40
A41-60
## ExprssnNtrl -
0.661
## ExprssnHppy -
0.631  0.487
## ExprssnAngr -
0.645  0.501  0.476
```

```
## Age 7-8     -0.238 -0.008  0.008 -
0.001
## Age 9-10    -0.206 -0.009  0.009 -
0.002  0.402
## Age18-22    -0.227 -0.012  0.012 -
0.004  0.446  0.394
## Age23-40    -0.250 -0.012  0.011 -
0.004  0.429  0.376  0.421
## Age41-60    -0.193 -0.008  0.008 -
0.002  0.344  0.303  0.338  0.342
## GenderMale  -0.179  0.003 -0.003  0.001  0.003 -
0.010  0.004  0.203  0.090
## convergence code: 0
## Model failed to converge with max|grad| = 0.00250933 (tol = 0.002,
component 1)
HumanData$Age=relevel(HumanData$Age," 7-8")
FullGLMM
<- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID), data
= HumanData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
control$checkConv, :
## Model failed to converge with max|grad| = 0.00208998 (tol = 0.002,
component 1)
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: HumanData
##
##      AIC      BIC   logLik deviance df.resid
##   1631.9   1703.6   -803.9   1607.9     2900
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -10.5629   0.1202   0.2156   0.3333   1.3365
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3285   0.5732
##  Image  (Intercept) 0.5746   0.7580
## Number of obs: 2912, groups:  ID, 180; Image, 16
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)         2.3786     0.4474   5.316 1.06e-07 ***
## ExpressionNeutral  -0.7820     0.5661  -1.381 0.167184
## ExpressionHappy     1.1580     0.5959   1.943 0.051962 .
## ExpressionAngry    -0.1275     0.5786  -0.220 0.825545
## Age 5-6            -0.8004     0.2411  -3.320 0.000901 ***
## Age 9-10            0.4288     0.2863   1.498 0.134220
## Age18-22            1.1481     0.2606   4.406 1.05e-05 ***
## Age23-40            1.0460     0.2723   3.841 0.000123 ***
## Age41-60            0.7517     0.3327   2.259 0.023866 *
```

```
## GenderMale         -0.2835     0.1725  -1.643 0.100390
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsN ExprsH ExprsA Age5-6 Ag9-10 A18-22 A23-40
A41-60
## ExprssnNtrl -
0.652
## ExprssnHppy -
0.614  0.487
## ExprssnAngr -
0.633  0.501  0.476
## Age 5-6     -0.306  0.008 -
0.008  0.001
## Age 9-10    -0.243 -0.002  0.002 -
0.001  0.450
## Age18-22    -0.266 -0.005  0.004 -
0.002  0.491  0.424
## Age23-40    -0.284 -0.005  0.003 -
0.002  0.465  0.403  0.448
## Age41-60    -0.225 -0.003  0.002 -
0.001  0.386  0.331  0.366  0.366
## GenderMale  -0.174  0.003 -0.003  0.001 -0.003 -
0.012  0.002  0.197  0.086
## convergence code: 0
## Model failed to converge with max|grad| = 0.00208998 (tol = 0.002,
component 1)
HumanData$Age=relevel(HumanData$Age," 9-10")
FullGLMM
<- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID), data
= HumanData,family = "binomial")
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: HumanData
##
##      AIC      BIC   logLik deviance df.resid
##   1631.9   1703.6   -803.9   1607.9     2900
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -10.5636   0.1202   0.2155   0.3333   1.3364
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3285   0.5731
##  Image  (Intercept) 0.5747   0.7581
## Number of obs: 2912, groups:  ID, 180; Image, 16
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
```

```
## (Intercept)         2.8077     0.4688   5.989 2.11e-09 ***
## ExpressionNeutral  -0.7820     0.5660  -1.382   0.1671
## ExpressionHappy     1.1578     0.5958   1.943   0.0520 .
## ExpressionAngry    -0.1276     0.5785  -0.221   0.8255
## Age 7-8            -0.4288     0.2863  -1.498   0.1342
## Age 5-6            -1.2291     0.2793  -4.400 1.08e-05 ***
## Age18-22            0.7194     0.2942   2.446   0.0145 *
## Age23-40            0.6170     0.3053   2.021   0.0433 *
## Age41-60            0.3229     0.3599   0.897   0.3696
## GenderMale         -0.2836     0.1725  -1.644   0.1002
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsN ExprsH ExprsA Age7-8 Age5-6 A18-22 A23-40
A41-60
## ExprssnNtrl -
0.623
## ExprssnHppy -
0.585  0.487
## ExprssnAngr -
0.604  0.500  0.476
## Age 7-8     -0.379  0.002 -
0.002  0.001
## Age 5-6     -0.403  0.009 -
0.009  0.002  0.637
## Age18-22    -0.363 -0.002  0.002 -
0.001  0.597  0.610
## Age23-40    -0.377 -0.002  0.002 -
0.001  0.578  0.586  0.564
## Age41-60    -0.313 -0.001  0.001 -
0.001  0.489  0.501  0.477  0.475
## GenderMale  -0.173  0.003 -
0.003  0.001  0.012  0.010  0.013  0.187  0.089
HumanData$Age=relevel(HumanData$Age,"18-22")
FullGLMM
<- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID), data
= HumanData,family = "binomial")
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: HumanData
##
##      AIC      BIC   logLik deviance df.resid
##   1631.9   1703.6   -803.9   1607.9     2900
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -10.5622   0.1203   0.2156   0.3333   1.3364
##
## Random effects:
##  Groups Name        Variance Std.Dev.
```

```
##  ID     (Intercept) 0.3284   0.573
##  Image  (Intercept) 0.5746   0.758
## Number of obs: 2912, groups:  ID, 180; Image, 16
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)         3.5274     0.4538   7.773 7.66e-15 ***
## ExpressionNeutral  -0.7826     0.5658  -1.383   0.1666
## ExpressionHappy     1.1569     0.5955   1.943   0.0521 .
## ExpressionAngry    -0.1283     0.5782  -0.222   0.8244
## Age 9-10           -0.7192     0.2941  -2.445   0.0145 *
## Age 7-8            -1.1480     0.2605  -4.407 1.05e-05 ***
## Age 5-6            -1.9484     0.2535  -7.685 1.53e-14 ***
## Age23-40           -0.1023     0.2802  -0.365   0.7150
## Age41-60           -0.3962     0.3393  -1.168   0.2429
## GenderMale         -0.2836     0.1725  -1.644   0.1002
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsN ExprsH ExprsA Ag9-10 Age7-8 Age5-6 A23-40
A41-60
## ExprssnNtrl -
0.645
## ExprssnHppy -
0.603  0.487
## ExprssnAngr -
0.625  0.500  0.476
## Age 9-10    -0.273  0.002 -
0.002  0.001
## Age 7-8     -0.312  0.005 -
0.004  0.002  0.473
## Age 5-6     -0.339  0.012 -
0.012  0.004  0.488  0.560
## Age23-40    -
0.313  0.000  0.000  0.000  0.436  0.495  0.504
## Age41-60    -0.251  0.001 -
0.001  0.001  0.361  0.409  0.422  0.395
## GenderMale  -0.170  0.003 -0.003  0.001 -0.013 -0.002 -
0.004  0.190  0.083
HumanData$Age=relevel(HumanData$Age,"23-40")
FullGLMM
<- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID), data
= HumanData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
control$checkConv, :
## Model failed to converge with max|grad| = 0.00372956 (tol = 0.002,
component 1)
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: HumanData
```

```
##
##      AIC      BIC   logLik deviance df.resid
##   1631.9   1703.6   -803.9   1607.9     2900
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -10.5633   0.1202   0.2155   0.3332   1.3365
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3287   0.5733
##  Image  (Intercept) 0.5746   0.7580
## Number of obs: 2912, groups:  ID, 180; Image, 16
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)         3.4247     0.4527   7.565 3.87e-14 ***
## ExpressionNeutral  -0.7824     0.5659  -1.383 0.166808
## ExpressionHappy     1.1576     0.5956   1.944 0.051935 .
## ExpressionAngry    -0.1279     0.5783  -0.221 0.825014
## Age18-22            0.1026     0.2802   0.366 0.714294
## Age 9-10           -0.6167     0.3053  -2.020 0.043383 *
## Age 7-8            -1.0456     0.2723  -3.840 0.000123 ***
## Age 5-6            -1.8457     0.2669  -6.916 4.66e-12 ***
## Age41-60           -0.2933     0.3442  -0.852 0.394057
## GenderMale         -0.2837     0.1725  -1.644 0.100153
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsN ExprsH ExprsA A18-22 Ag9-10 Age7-8 Age5-6
A41-60
## ExprssnNtrl -
0.647
## ExprssnHppy -
0.605  0.487
## ExprssnAngr -
0.626  0.500  0.476
## Age18-22    -
0.305  0.000  0.000  0.000
## Age 9-10    -0.284  0.002 -
0.002  0.001  0.498
## Age 7-8     -0.321  0.005 -
0.004  0.002  0.555  0.514
## Age 5-6     -0.347  0.012 -
0.011  0.003  0.571  0.530  0.600
## Age41-60    -0.255  0.001 -
0.001  0.001  0.424  0.391  0.437  0.451
## GenderMale  -0.054  0.003 -0.003  0.001 -0.190 -0.187 -0.197 -0.203 -
0.072
## convergence code: 0
## Model failed to converge with max|grad| = 0.00372956 (tol = 0.002,
component 1)
HumanData$Age=relevel(HumanData$Age,"41-60")
```

```
FullGLMM
<- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID), data
= HumanData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
control$checkConv, :
## Model failed to converge with max|grad| = 0.00267207 (tol = 0.002,
component 1)
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: HumanData
##
##      AIC      BIC   logLik deviance df.resid
##   1631.9   1703.6   -803.9   1607.9     2900
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -10.5641   0.1202   0.2155   0.3332   1.3365
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3286   0.5732
##  Image  (Intercept) 0.5749   0.7582
## Number of obs: 2912, groups:  ID, 180; Image, 16
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)         3.1307     0.4939   6.338 2.32e-10 ***
## ExpressionNeutral  -0.7829     0.5662  -1.383   0.1668
## ExpressionHappy     1.1575     0.5960   1.942   0.0521 .
## ExpressionAngry    -0.1274     0.5786  -0.220   0.8258
## Age23-40            0.2943     0.3442   0.855   0.3925
## Age18-22            0.3969     0.3394   1.170   0.2422
## Age 9-10           -0.3228     0.3599  -0.897   0.3699
## Age 7-8            -0.7515     0.3327  -2.259   0.0239 *
## Age 5-6            -1.5518     0.3269  -4.747 2.06e-06 ***
## GenderMale         -0.2834     0.1725  -1.643   0.1004
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsN ExprsH ExprsA A23-40 A18-22 Ag9-10 Age7-8
Age5-6
## ExprssnNtrl -
0.593
## ExprssnHppy -
0.555  0.487
## ExprssnAngr -
0.574  0.501  0.476
## Age23-40    -0.463 -0.001  0.001 -
0.001
## Age18-22    -0.456 -0.001  0.001 -
```

```
0.001  0.664
## Age 9-10    -
0.432  0.001  0.000  0.000  0.625  0.647
## Age 7-8     -0.470  0.003 -
0.002  0.001  0.677  0.700  0.661
## Age 5-6     -0.491  0.008 -
0.008  0.002  0.685  0.711  0.673  0.733
## GenderMale  -0.099  0.003 -0.003  0.001  0.072 -0.083 -0.089 -0.086 -
0.090
## convergence code: 0
## Model failed to converge with max|grad| = 0.00267207 (tol = 0.002,
component 1)
null <- lmer(Correct ~ 1 + (1 | ID), data = HumanData,REML = FALSE)
summary(null)
## Linear mixed model fit by maximum likelihood  ['lmerMod']
## Formula: Correct ~ 1 + (1 | ID)
##    Data: HumanData
##
##      AIC      BIC   logLik deviance df.resid
##   1211.1   1229.0   -602.5   1205.1     2909
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.1652  0.1610  0.2753  0.3897  1.0760
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  ID       (Intercept) 0.006001 0.07746
##  Residual             0.084478 0.29065
## Number of obs: 2912, groups:  ID, 180
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept) 0.900050   0.007903   113.9
anova(null, FullGLMM)
## Data: HumanData
## Models:
## null: Correct ~ 1 + (1 | ID)
## FullGLMM: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##          npar    AIC    BIC  logLik deviance Chisq Df Pr(>Chisq)
## null        3 1211.1 1229.0 -602.55   1205.1
## FullGLMM   12 1631.9 1703.6 -803.95   1607.9     0  9          1
Full
<- glmer(Correct ~ Expression + Age + Expression:Age + (1|Image) + (1|ID),
 data = HumanData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
control$checkConv, :
## Model failed to converge with max|grad| = 0.0103888 (tol = 0.002,
component 1)
summary(Full)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Expression:Age + (1 | Image) + (1
```

```
|
##     ID)
##    Data: HumanData
##
##      AIC      BIC   logLik deviance df.resid
##   1608.2   1763.6   -778.1   1556.2     2886
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -9.6249  0.1279  0.1912  0.3111  1.7683
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.4026   0.6345
##  Image  (Intercept) 0.5573   0.7465
## Number of obs: 2912, groups:  ID, 180; Image, 16
##
## Fixed effects:
##                            Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 4.5270     1.0360   4.370 1.24e-05 ***
## ExpressionNeutral          -1.7515     1.1811  -1.483  0.13809
## ExpressionHappy            -1.5275     1.1933  -1.280  0.20051
## ExpressionAngry            -2.0642     1.1561  -1.786  0.07418 .
## Age23-40                   -1.6512     1.0124  -1.631  0.10289
## Age18-22                   -0.6307     1.0617  -0.594  0.55246
## Age 9-10                   -1.7600     1.0475  -1.680  0.09293 .
## Age 7-8                    -2.3052     1.0096  -2.283  0.02241 *
## Age 5-6                    -3.0895     0.9996  -3.091  0.00200 **
## ExpressionNeutral:Age23-40  2.4412     1.1671   2.092  0.03646 *
## ExpressionHappy:Age23-40    3.3337     1.2929   2.578  0.00992 **
## ExpressionAngry:Age23-40    2.1545     1.0982   1.962  0.04979 *
## ExpressionNeutral:Age18-22  0.8354     1.1809   0.707  0.47928
## ExpressionHappy:Age18-22    1.6624     1.2480   1.332  0.18286
## ExpressionAngry:Age18-22    1.0662     1.1404   0.935  0.34984
## ExpressionNeutral:Age 9-10  1.1550     1.1684   0.988  0.32292
## ExpressionHappy:Age 9-10    3.4976     1.4778   2.367  0.01794 *
## ExpressionAngry:Age 9-10    1.4177     1.1339   1.250  0.21121
## ExpressionNeutral:Age 7-8   1.0839     1.1156   0.972  0.33127
## ExpressionHappy:Age 7-8     2.5056     1.1749   2.133  0.03295 *
## ExpressionAngry:Age 7-8     2.0579     1.0921   1.884  0.05952 .
## ExpressionNeutral:Age 5-6   0.2930     1.1005   0.266  0.79003
## ExpressionHappy:Age 5-6     3.3899     1.1801   2.873  0.00407 **
## ExpressionAngry:Age 5-6     2.8156     1.0846   2.596  0.00943 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation matrix not shown by default, as p = 24 > 12.
## Use print(x, correlation=TRUE)  or
##     vcov(x)        if you need it
## convergence code: 0
## Model failed to converge with max|grad| = 0.0103888 (tol = 0.002,
component 1)
```

MonkeyAllAgesGLMM

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see http://rmarkdown.rstudio.com.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
install.packages("readxl")
## Installing package into '/home/rstudio-user/R/x86_64-pc-linux-gnu-
library/3.6'
## (as 'lib' is unspecified)
install.packages("car")
## Installing package into '/home/rstudio-user/R/x86_64-pc-linux-gnu-
library/3.6'
## (as 'lib' is unspecified)
install.packages("lme4")
## Installing package into '/home/rstudio-user/R/x86_64-pc-linux-gnu-
library/3.6'
## (as 'lib' is unspecified)
install.packages("languageR")
## Installing package into '/home/rstudio-user/R/x86_64-pc-linux-gnu-
library/3.6'
## (as 'lib' is unspecified)
library("readxl")
library("car")
## Loading required package: carData
library("lme4")
## Loading required package: Matrix
## Registered S3 methods overwritten by 'lme4':
##   method                          from
##   cooks.distance.influence.merMod car
##   influence.merMod                car
##   dfbeta.influence.merMod         car
##   dfbetas.influence.merMod        car
library("languageR")
MonkeyData <- read.csv("../project/MonkeyAllAgesQ.csv")
head(MonkeyData)
##   ID Expression       Image Species Correct  Age Gender
## 1 98     Scared Distressed1  Monkey       0  5-6 Female
## 2 98     Scared Distressed2  Monkey       0  5-6 Female
## 3 98     Scared Distressed3  Monkey       0  5-6 Female
## 4 98     Scared Distressed4  Monkey       0  5-6 Female
## 5 98    Neutral    Neutral1  Monkey       0  5-6 Female
## 6 98    Neutral    Neutral2  Monkey       1  5-6 Female
 FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID
), data = MonkeyData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl
= control$checkConv, :
## Model failed to converge with max|grad| = 0.0273106 (tol = 0.002,
component 1)
summary (FullGLMM)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3263.4   3344.0  -1618.7   3237.4     3627
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0404 -0.4968 -0.2832  0.6054  9.6081
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.0916   0.3027
##  Image  (Intercept) 0.8595   0.9271
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                     Estimate Std. Error z value Pr(>|z|)
## (Intercept)         -3.76468    0.53787  -6.999 2.57e-12 ***
## ExpressionHappy      2.92977    0.70219   4.172 3.01e-05 ***
## ExpressionNeutral    2.82261    0.70237   4.019 5.85e-05 ***
## ExpressionScared     0.91159    0.71098   1.282  0.19979
## ExpressionVeryAngry  3.06631    0.70223   4.367 1.26e-05 ***
## Age 7-8              0.21807    0.18004   1.211  0.22580
## Age 9-10             0.23687    0.19357   1.224  0.22106
## Age18-22             0.37758    0.16362   2.308  0.02102 *
## Age23-40             0.47048    0.17032   2.762  0.00574 **
## Age41-60             0.38208    0.20804   1.837  0.06627 .
## GenderMale           0.03772    0.11052   0.341  0.73288
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsH ExprsN ExprsS ExprVA Age7-8 Ag9-10 A18-22
A23-40
## ExprssnHppy -
0.719
## ExprssnNtrl -
0.718  0.549
## ExprssnScrd -
0.707  0.542  0.541
## ExprssnVryA -
0.718  0.549  0.549  0.541
## Age 7-8     -
0.179  0.003  0.003  0.001  0.003
## Age 9-10    -
0.168  0.003  0.003  0.001  0.003  0.485
## Age18-22    -
0.202  0.005  0.005  0.001  0.006  0.574  0.537
## Age23-40    -
0.213  0.006  0.006  0.001  0.007  0.554  0.519  0.616
```

```
## Age41-60    -
0.167  0.004  0.004  0.001  0.004  0.452  0.424  0.502  0.504
## GenderMale  -
0.090  0.001  0.001  0.000  0.001  0.008  0.015  0.020  0.216
##             A41-60
## ExprssnHppy
## ExprssnNtrl
## ExprssnScrd
## ExprssnVryA
## Age 7-8
## Age 9-10
## Age18-22
## Age23-40
## Age41-60
## GenderMale   0.106
## convergence code: 0
## Model failed to converge with max|grad| = 0.0273106 (tol = 0.002,
component 1)
MonkeyData$Expression=relevel(MonkeyData$Expression,"Happy")
FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID)
, data = MonkeyData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl
= control$checkConv, :
## Model failed to converge with max|grad| = 0.00530048 (tol = 0.002,
component 1)
summary(FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3263.4   3344.0  -1618.7   3237.4     3627
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0391 -0.4963 -0.2830  0.6056  9.6288
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.09141  0.3023
##  Image  (Intercept) 0.86570  0.9304
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                     Estimate Std. Error z value Pr(>|z|)
## (Intercept)         -0.83244    0.49038  -1.698  0.08959 .
## ExpressionAngry     -2.93807    0.70337  -4.177 2.95e-05 ***
## ExpressionNeutral   -0.10594    0.66877  -0.158  0.87413
## ExpressionScared    -2.02207    0.67834  -2.981  0.00287 **
## ExpressionVeryAngry  0.13294    0.66852   0.199  0.84238
## Age 7-8              0.22038    0.17999   1.224  0.22080
## Age 9-10             0.23726    0.19352   1.226  0.22018
```

```
## Age18-22             0.37812    0.16359   2.311  0.02081 *
## Age23-40             0.47072    0.17028   2.764  0.00570 **
## Age41-60             0.38317    0.20798   1.842  0.06543 .
## GenderMale           0.03593    0.11050   0.325  0.74508
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsA ExprsN ExprsS ExprVA Age7-8 Ag9-10 A18-22
A23-40
## ExprssnAngr -
0.645
## ExprssnNtrl -
0.680  0.474
## ExprssnScrd -
0.669  0.469  0.492
## ExprssnVryA -
0.681  0.474  0.499  0.492
## Age 7-8     -0.192 -0.003  0.000 -
0.002  0.000
## Age 9-10    -0.180 -0.002  0.000 -
0.002  0.000  0.485
## Age18-22    -0.214 -0.005  0.000 -
0.004  0.001  0.574  0.537
## Age23-40    -0.225 -0.006  0.000 -
0.005  0.001  0.554  0.519  0.616
## Age41-60    -0.177 -0.004  0.000 -
0.003  0.000  0.453  0.424  0.502  0.504
## GenderMale  -
0.097  0.000  0.000  0.000  0.000  0.008  0.015  0.020  0.216
##             A41-60
## ExprssnAngr
## ExprssnNtrl
## ExprssnScrd
## ExprssnVryA
## Age 7-8
## Age 9-10
## Age18-22
## Age23-40
## Age41-60
## GenderMale   0.106
## convergence code: 0
## Model failed to converge with max|grad| = 0.00530048 (tol = 0.002,
component 1)
MonkeyData$Expression=relevel(MonkeyData$Expression,"Neutral")
FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID)
, data = MonkeyData,family = "binomial")
summary(FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: MonkeyData
##
```

```
##      AIC      BIC   logLik deviance df.resid
##   3263.4   3344.0  -1618.7   3237.4     3627
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0389 -0.4963 -0.2831  0.6057  9.6255
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.09135  0.3022
##  Image  (Intercept) 0.86524  0.9302
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                     Estimate Std. Error z value Pr(>|z|)
## (Intercept)         -0.93816    0.49199  -1.907  0.05654 .
## ExpressionHappy      0.10460    0.66942   0.156  0.87584
## ExpressionAngry     -2.83123    0.70460  -4.018 5.86e-05 ***
## ExpressionScared    -1.91502    0.67965  -2.818  0.00484 **
## ExpressionVeryAngry  0.23955    0.67003   0.358  0.72071
## Age 7-8              0.21977    0.18000   1.221  0.22209
## Age 9-10             0.23720    0.19352   1.226  0.22033
## Age18-22             0.37805    0.16359   2.311  0.02083 *
## Age23-40             0.47023    0.17028   2.762  0.00575 **
## Age41-60             0.38272    0.20798   1.840  0.06574 .
## GenderMale           0.03576    0.11050   0.324  0.74625
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsH ExprsA ExprsS ExprVA Age7-8 Ag9-10 A18-22
A23-40
## ExprssnHppy -
0.682
## ExprssnAngr -
0.646  0.476
## ExprssnScrd -
0.671  0.494  0.470
## ExprssnVryA -
0.682  0.501  0.476  0.494
## Age 7-8     -0.192  0.000 -0.003 -
0.002  0.000
## Age 9-10    -0.180  0.000 -0.002 -
0.002  0.000  0.485
## Age18-22    -0.213  0.000 -0.005 -
0.004  0.001  0.574  0.537
## Age23-40    -0.224  0.000 -0.006 -
0.004  0.001  0.554  0.519  0.616
## Age41-60    -0.177  0.000 -0.004 -
0.003  0.001  0.453  0.424  0.502  0.504
## GenderMale  -
0.097  0.000  0.000  0.000  0.000  0.008  0.015  0.020  0.216
##             A41-60
## ExprssnHppy
```

```
## ExprssnAngr
## ExprssnScrd
## ExprssnVryA
## Age 7-8
## Age 9-10
## Age18-22
## Age23-40
## Age41-60
## GenderMale   0.106
MonkeyData$Expression=relevel(MonkeyData$Expression,"Scared")
FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID)
, data = MonkeyData,family = "binomial")
summary(FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3263.4   3344.0  -1618.7   3237.4     3627
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0389 -0.4963 -0.2831  0.6057  9.6264
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.09137  0.3023
##  Image  (Intercept) 0.86553  0.9303
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                     Estimate Std. Error z value Pr(>|z|)
## (Intercept)         -2.85300    0.50546  -5.644 1.66e-08 ***
## ExpressionNeutral    1.91487    0.67928   2.819  0.00482 **
## ExpressionHappy      2.01980    0.67881   2.975  0.00293 **
## ExpressionAngry     -0.91646    0.71289  -1.286  0.19859
## ExpressionVeryAngry  2.15454    0.67924   3.172  0.00151 **
## Age 7-8              0.21972    0.17998   1.221  0.22217
## Age 9-10             0.23708    0.19351   1.225  0.22052
## Age18-22             0.37793    0.16358   2.310  0.02087 *
## Age23-40             0.47017    0.17027   2.761  0.00576 **
## Age41-60             0.38276    0.20797   1.840  0.06570 .
## GenderMale           0.03574    0.11050   0.323  0.74633
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsN ExprsH ExprsA ExprVA Age7-8 Ag9-10 A18-22
A23-40
## ExprssnNtrl -
0.692
## ExprssnHppy -
```

```
0.693  0.515
## ExprssnAngr -
0.657  0.489  0.489
## ExprssnVryA -
0.693  0.514  0.515  0.489
## Age 7-8     -0.190  0.002  0.002 -
0.001  0.003
## Age 9-10    -
0.178  0.002  0.002  0.000  0.002  0.485
## Age18-22    -0.213  0.004  0.004 -
0.001  0.005  0.574  0.537
## Age23-40    -0.224  0.005  0.005 -
0.001  0.005  0.554  0.519  0.616
## Age41-60    -0.176  0.003  0.003 -
0.001  0.004  0.452  0.424  0.502  0.504
## GenderMale  -
0.095  0.000  0.000  0.000  0.000  0.008  0.015  0.020  0.216
##             A41-60
## ExprssnNtrl
## ExprssnHppy
## ExprssnAngr
## ExprssnVryA
## Age 7-8
## Age 9-10
## Age18-22
## Age23-40
## Age41-60
## GenderMale   0.106
MonkeyData$Expression=relevel(MonkeyData$Expression,"VeryAngry")
FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID)
, data = MonkeyData,family = "binomial")
summary(FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3263.4   3344.0  -1618.7   3237.4     3627
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0389 -0.4963 -0.2831  0.6057  9.6263
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.09138  0.3023
##  Image  (Intercept) 0.86541  0.9303
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)       -0.69861    0.49101  -1.423  0.15479
```

```
## ExpressionScared  -2.15435    0.67898  -3.173  0.00151 **
## ExpressionNeutral -0.23946    0.66934  -0.358  0.72052
## ExpressionHappy   -0.13458    0.66882  -0.201  0.84052
## ExpressionAngry   -3.07096    0.70400  -4.362 1.29e-05 ***
## Age 7-8            0.21974    0.17998   1.221  0.22211
## Age 9-10           0.23710    0.19350   1.225  0.22047
## Age18-22           0.37792    0.16357   2.310  0.02086 *
## Age23-40           0.47017    0.17026   2.761  0.00575 **
## Age41-60           0.38272    0.20797   1.840  0.06573 .
## GenderMale         0.03573    0.11050   0.323  0.74640
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsS ExprsN ExprsH ExprsA Age7-8 Ag9-10 A18-22
A23-40
## ExprssnScrd -
0.670
## ExprssnNtrl -
0.681  0.493
## ExprssnHppy -
0.682  0.493  0.500
## ExprssnAngr -
0.646  0.470  0.475  0.475
## Age 7-8     -0.192 -0.003  0.000  0.000 -
0.003
## Age 9-10    -0.180 -0.002  0.000  0.000 -
0.003  0.485
## Age18-22    -0.213 -0.005 -0.001 -0.001 -
0.005  0.574  0.537
## Age23-40    -0.223 -0.005 -0.001 -0.001 -
0.006  0.553  0.519  0.616
## Age41-60    -0.176 -0.004 -0.001  0.000 -
0.004  0.452  0.424  0.502  0.504
## GenderMale  -0.097  0.000  0.000  0.000 -
0.001  0.008  0.015  0.020  0.216
##             A41-60
## ExprssnScrd
## ExprssnNtrl
## ExprssnHppy
## ExprssnAngr
## Age 7-8
## Age 9-10
## Age18-22
## Age23-40
## Age41-60
## GenderMale   0.106
MonkeyData$Age=relevel(MonkeyData$Age," 7-8")
FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID)
, data = MonkeyData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl
= control$checkConv, :
## Model failed to converge with max|grad| = 0.00473136 (tol = 0.002,
component 1)
```

```
summary(FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3263.4   3344.0  -1618.7   3237.4     3627
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0388 -0.4964 -0.2831  0.6057  9.6236
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.0913   0.3022
##  Image  (Intercept) 0.8648   0.9299
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)       -0.47939    0.48928  -0.980   0.3272
## ExpressionScared  -2.15394    0.67848  -3.175   0.0015 **
## ExpressionNeutral -0.23830    0.66903  -0.356   0.7217
## ExpressionHappy   -0.13494    0.66866  -0.202   0.8401
## ExpressionAngry   -3.06959    0.70351  -4.363 1.28e-05 ***
## Age 5-6           -0.21943    0.17997  -1.219   0.2227
## Age 9-10           0.01748    0.18984   0.092   0.9266
## Age18-22           0.15841    0.15915   0.995   0.3196
## Age23-40           0.25057    0.16570   1.512   0.1305
## Age41-60           0.16263    0.20437   0.796   0.4262
## GenderMale         0.03595    0.11049   0.325   0.7449
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsS ExprsN ExprsH ExprsA Age5-6 Ag9-10 A18-22
A23-40
## ExprssnScrd -
0.673
## ExprssnNtrl -
0.683  0.493
## ExprssnHppy -
0.684  0.493  0.500
## ExprssnAngr -
0.648  0.469  0.475  0.475
## Age 5-6     -
0.175  0.003  0.000  0.000  0.003
## Age 9-10    -
0.168  0.000  0.000  0.000  0.000  0.454
## Age18-22    -0.201 -0.002  0.000  0.000 -
0.002  0.541  0.516
## Age23-40    -0.212 -0.003  0.000  0.000 -
```

```
0.003  0.517  0.497  0.594
## Age41-60    -0.165 -0.001  0.000  0.000 -
0.002  0.420  0.403  0.481  0.482
## GenderMale  -0.094  0.000  0.000  0.000  0.000 -
0.008  0.007  0.011  0.213
##             A41-60
## ExprssnScrd
## ExprssnNtrl
## ExprssnHppy
## ExprssnAngr
## Age 5-6
## Age 9-10
## Age18-22
## Age23-40
## Age41-60
## GenderMale   0.100
## convergence code: 0
## Model failed to converge with max|grad| = 0.00473136 (tol = 0.002,
component 1)
MonkeyData$Age=relevel(MonkeyData$Age," 9-10")
FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID)
, data = MonkeyData,family = "binomial")
summary(FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3263.4   3344.0  -1618.7   3237.4     3627
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0389 -0.4963 -0.2831  0.6057  9.6271
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.09138  0.3023
##  Image  (Intercept) 0.86567  0.9304
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)       -0.46108    0.49391  -0.934  0.35054
## ExpressionScared  -2.15494    0.67839  -3.177  0.00149 **
## ExpressionNeutral -0.23987    0.66890  -0.359  0.71989
## ExpressionHappy   -0.13522    0.66843  -0.202  0.83969
## ExpressionAngry   -3.07147    0.70343  -4.366 1.26e-05 ***
## Age 7-8           -0.01735    0.18985  -0.091  0.92717
## Age 5-6           -0.23703    0.19350  -1.225  0.22058
## Age18-22           0.14091    0.17373   0.811  0.41732
## Age23-40           0.23313    0.17948   1.299  0.19395
## Age41-60           0.14570    0.21579   0.675  0.49955
```

```
## GenderMale         0.03568    0.11050   0.323  0.74674
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsS ExprsN ExprsH ExprsA Age7-8 Age5-6 A18-22
A23-40
## ExprssnScrd -
0.666
## ExprssnNtrl -
0.676  0.492
## ExprssnHppy -
0.677  0.493  0.499
## ExprssnAngr -
0.642  0.469  0.474  0.475
## Age 7-8     -
0.217  0.000  0.000  0.000  0.000
## Age 5-6     -
0.213  0.002  0.000  0.000  0.003  0.559
## Age18-22    -0.238 -0.002  0.000  0.000 -
0.002  0.620  0.608
## Age23-40    -0.247 -0.003  0.000  0.000 -
0.003  0.599  0.585  0.657
## Age41-60    -0.200 -0.001  0.000  0.000 -
0.002  0.498  0.488  0.546  0.545
## GenderMale  -0.091  0.000  0.000  0.000 -0.001 -0.007 -
0.015  0.002  0.189
##             A41-60
## ExprssnScrd
## ExprssnNtrl
## ExprssnHppy
## ExprssnAngr
## Age 7-8
## Age 5-6
## Age18-22
## Age23-40
## Age41-60
## GenderMale   0.089
MonkeyData$Age=relevel(MonkeyData$Age,"18-22")
FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID)
, data = MonkeyData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl
= control$checkConv, :
## Model failed to converge with max|grad| = 0.00226418 (tol = 0.002,
component 1)
summary(FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3263.4   3344.0  -1618.7   3237.4     3627
```

```
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0389 -0.4963 -0.2831  0.6057  9.6271
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.09138  0.3023
##  Image  (Intercept) 0.86562  0.9304
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)       -0.32052    0.48315  -0.663   0.5071
## ExpressionScared  -2.15425    0.67871  -3.174   0.0015 **
## ExpressionNeutral -0.24015    0.66902  -0.359   0.7196
## ExpressionHappy   -0.13489    0.66866  -0.202   0.8401
## ExpressionAngry   -3.07150    0.70367  -4.365 1.27e-05 ***
## Age 9-10          -0.14073    0.17374  -0.810   0.4179
## Age 7-8           -0.15811    0.15916  -0.993   0.3205
## Age 5-6           -0.37790    0.16357  -2.310   0.0209 *
## Age23-40           0.09234    0.14646   0.630   0.5284
## Age41-60           0.00476    0.18928   0.025   0.9799
## GenderMale         0.03565    0.11050   0.323   0.7470
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsS ExprsN ExprsH ExprsA Ag9-10 Age7-8 Age5-6
A23-40
## ExprssnScrd -
0.682
## ExprssnNtrl -
0.692  0.492
## ExprssnHppy -
0.692  0.493  0.500
## ExprssnAngr -
0.657  0.469  0.475  0.475
## Age 9-10    -
0.116  0.002  0.000  0.000  0.002
## Age 7-8     -
0.126  0.002  0.000  0.000  0.002  0.352
## Age 5-6     -
0.122  0.004  0.001  0.001  0.005  0.343  0.378
## Age23-40    -0.158 -0.001  0.000  0.000 -
0.002  0.382  0.414  0.401
## Age41-60    -
0.115  0.000  0.000  0.000  0.000  0.296  0.322  0.312  0.373
## GenderMale  -0.092  0.000  0.000  0.000 -0.001 -0.002 -0.011 -
0.020  0.228
##             A41-60
## ExprssnScrd
## ExprssnNtrl
## ExprssnHppy
```

```
## ExprssnAngr
## Age 9-10
## Age 7-8
## Age 5-6
## Age23-40
## Age41-60
## GenderMale   0.099
## convergence code: 0
## Model failed to converge with max|grad| = 0.00226418 (tol = 0.002,
component 1)
MonkeyData$Age=relevel(MonkeyData$Age,"23-40")
FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID)
, data = MonkeyData,family = "binomial")
summary(FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3263.4   3344.0  -1618.7   3237.4     3627
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0389 -0.4963 -0.2831  0.6057  9.6266
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.09137  0.3023
##  Image  (Intercept) 0.86555  0.9304
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)       -0.22825    0.48244  -0.473  0.63613
## ExpressionScared  -2.15449    0.67892  -3.173  0.00151 **
## ExpressionNeutral -0.23985    0.66940  -0.358  0.72011
## ExpressionHappy   -0.13475    0.66895  -0.201  0.84035
## ExpressionAngry   -3.07107    0.70378  -4.364 1.28e-05 ***
## Age18-22          -0.09225    0.14646  -0.630  0.52878
## Age 9-10          -0.23311    0.17949  -1.299  0.19404
## Age 7-8           -0.25047    0.16571  -1.511  0.13066
## Age 5-6           -0.47020    0.17027  -2.762  0.00575 **
## Age41-60          -0.08742    0.19124  -0.457  0.64756
## GenderMale         0.03572    0.11050   0.323  0.74648
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsS ExprsN ExprsH ExprsA A18-22 Ag9-10 Age7-8
Age5-6
## ExprssnScrd -
0.684
```

```
## ExprssnNtrl -
0.693  0.493
## ExprssnHppy -
0.694  0.493  0.500
## ExprssnAngr -
0.659  0.469  0.475  0.475
## Age18-22    -
0.145  0.001  0.000  0.000  0.001
## Age 9-10    -
0.119  0.003  0.000  0.000  0.003  0.447
## Age 7-8     -
0.129  0.003  0.000  0.000  0.003  0.486  0.397
## Age 5-6     -
0.126  0.005  0.001  0.001  0.006  0.475  0.389  0.426
## Age41-60    -
0.114  0.001  0.000  0.000  0.001  0.396  0.324  0.351  0.343
## GenderMale  -0.023  0.000  0.000  0.000 -0.001 -0.228 -0.189 -0.213 -
0.216
##             A41-60
## ExprssnScrd
## ExprssnNtrl
## ExprssnHppy
## ExprssnAngr
## Age18-22
## Age 9-10
## Age 7-8
## Age 5-6
## Age41-60
## GenderMale  -0.077
MonkeyData$Age=relevel(MonkeyData$Age,"41-60")
FullGLMM <- glmer(Correct ~ Expression + Age + Gender + (1|Image) + (1|ID)
, data = MonkeyData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl
= control$checkConv, :
## Model failed to converge with max|grad| = 0.0227898 (tol = 0.002,
component 1)
summary(FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3263.4   3344.0  -1618.7   3237.4     3627
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.0388 -0.4965 -0.2832  0.6056  9.6093
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.09118  0.3020
##  Image  (Intercept) 0.86046  0.9276
```

```
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                     Estimate Std. Error z value Pr(>|z|)
## (Intercept)       -0.322903   0.496814  -0.650  0.51573
## ExpressionScared  -2.150739   0.676728  -3.178  0.00148 **
## ExpressionNeutral -0.233232   0.667095  -0.350  0.72662
## ExpressionHappy   -0.128777   0.666565  -0.193  0.84681
## ExpressionAngry   -3.062917   0.701597  -4.366 1.27e-05 ***
## Age23-40           0.089825   0.191196   0.470  0.63849
## Age18-22          -0.001791   0.189236  -0.009  0.99245
## Age 9-10          -0.142864   0.215753  -0.662  0.50786
## Age 7-8           -0.160578   0.204339  -0.786  0.43196
## Age 5-6           -0.380994   0.207927  -1.832  0.06690 .
## GenderMale         0.036136   0.110470   0.327  0.74359
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) ExprsS ExprsN ExprsH ExprsA A23-40 A18-22 Ag9-10
Age7-8
## ExprssnScrd -
0.661
## ExprssnNtrl -
0.671  0.492
## ExprssnHppy -
0.671  0.493  0.500
## ExprssnAngr -
0.637  0.469  0.475  0.475
## Age23-40    -0.275 -0.001  0.000  0.000 -
0.001
## Age18-22    -
0.269  0.000  0.000  0.000  0.000  0.704
## Age 9-10    -
0.236  0.001  0.000  0.000  0.001  0.617  0.639
## Age 7-8     -
0.249  0.001  0.000  0.000  0.001  0.651  0.676  0.593
## Age 5-6     -
0.244  0.004  0.000  0.000  0.004  0.639  0.665  0.584  0.619
## GenderMale  -0.052  0.000  0.000  0.000 -0.001  0.077 -0.099 -0.089 -
0.100
##             Age5-6
## ExprssnScrd
## ExprssnNtrl
## ExprssnHppy
## ExprssnAngr
## Age23-40
## Age18-22
## Age 9-10
## Age 7-8
## Age 5-6
## GenderMale  -0.106
## convergence code: 0
## Model failed to converge with max|grad| = 0.0227898 (tol = 0.002,
```

```
component 1)
null <- lmer(Correct ~ 1 + (1 | ID), data = MonkeyData,REML = FALSE)
## boundary (singular) fit: see ?isSingular
summary(null)
## Linear mixed model fit by maximum likelihood  ['lmerMod']
## Formula: Correct ~ 1 + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   4384.5   4403.1  -2189.3   4378.5     3637
##
## Scaled residuals:
##    Min     1Q Median     3Q    Max
## -0.601 -0.601 -0.601  1.664  1.664
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  ID       (Intercept) 0.000    0.0000
##  Residual             0.195    0.4415
## Number of obs: 3640, groups:  ID, 180
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept) 0.265385   0.007318   36.26
## convergence code: 0
## boundary (singular) fit: see ?isSingular
anova(null, FullGLMM)
## Data: MonkeyData
## Models:
## null: Correct ~ 1 + (1 | ID)
## FullGLMM: Correct ~ Expression + Age + Gender + (1 | Image) + (1 | ID)
##          npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## null        3 4384.5 4403.1 -2189.3   4378.5
## FullGLMM   13 3263.4 3344.0 -1618.7   3237.4 1141.1 10  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Full
<- glmer(Correct ~ Expression + Age + Expression:Age + (1|Image) + (1|ID),
 data = MonkeyData,family = "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl
= control$checkConv, :
## Model failed to converge with max|grad| = 0.00739744 (tol = 0.002,
component 1)
summary(Full)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Age + Expression:Age + (1 | Image) + (1
|
##     ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3157.3   3355.6  -1546.6   3093.3     3608
```

```
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.9613 -0.4660 -0.2614  0.4336  9.1127
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.1261   0.3551
##  Image  (Intercept) 0.9737   0.9868
## Number of obs: 3640, groups:  ID, 180; Image, 20
##
## Fixed effects:
##                             Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  0.11001    0.57167   0.192  0.84740
## ExpressionScared            -2.82878    0.88322  -3.203  0.00136 **
## ExpressionNeutral            0.05960    0.80130   0.074  0.94071
## ExpressionHappy             -1.62853    0.81895  -1.989  0.04675 *
## ExpressionAngry             -4.16563    1.04688  -3.979 6.92e-05 ***
## Age23-40                    -0.46692    0.34265  -1.363  0.17299
## Age18-22                    -0.06354    0.33785  -0.188  0.85081
## Age 9-10                    -1.03544    0.38941  -2.659  0.00784 **
## Age 7-8                     -0.71364    0.36401  -1.961  0.04994 *
## Age 5-6                     -0.97950    0.36961  -2.650  0.00805 **
## ExpressionScared:Age23-40    1.04464    0.61408   1.701  0.08892 .
## ExpressionNeutral:Age23-40   0.33239    0.46734   0.711  0.47693
## ExpressionHappy:Age23-40     1.22571    0.49769   2.463  0.01379 *
## ExpressionAngry:Age23-40     0.69642    0.88227   0.789  0.42991
## ExpressionScared:Age18-22    0.27678    0.62041   0.446  0.65551
## ExpressionNeutral:Age18-22 -0.39911    0.46188  -0.864  0.38753
## ExpressionHappy:Age18-22     0.34151    0.49598   0.689  0.49110
## ExpressionAngry:Age18-22     1.05048    0.83082   1.264  0.20609
## ExpressionScared:Age 9-10    0.75985    0.74718   1.017  0.30917
## ExpressionNeutral:Age 9-10 -0.42082    0.54040  -0.779  0.43614
## ExpressionHappy:Age 9-10     2.78395    0.55066   5.056 4.29e-07 ***
## ExpressionAngry:Age 9-10     2.29882    0.88457   2.599  0.00936 **
## ExpressionScared:Age 7-8     1.01513    0.65829   1.542  0.12306
## ExpressionNeutral:Age 7-8   -0.60542    0.50500  -1.199  0.23059
## ExpressionHappy:Age 7-8      2.13871    0.52162   4.100 4.13e-05 ***
## ExpressionAngry:Age 7-8      0.59190    0.97621   0.606  0.54430
## ExpressionScared:Age 5-6     0.44442    0.73507   0.605  0.54545
## ExpressionNeutral:Age 5-6   -1.21436    0.53201  -2.283  0.02246 *
## ExpressionHappy:Age 5-6      2.74059    0.52716   5.199 2.01e-07 ***
## ExpressionAngry:Age 5-6      1.19275    0.93808   1.271  0.20356
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation matrix not shown by default, as p = 30 > 12.
## Use print(x, correlation=TRUE)  or
##     vcov(x)        if you need it
## convergence code: 0
## Model failed to converge with max|grad| = 0.00739744 (tol = 0.002,
component 1)
```

Appendix H2. R Data

Capuchin Adult Data R

```
install.packages("readxl")
install.packages("car")
install.packages("lme4")
install.packages("languageR")
library("readxl")
library("car")
library("lme4")
library("languageR")
MonkeyData <- read.csv("../project/June R DATA.csv")
head(MonkeyData)
##    ID Expression        Image Correct Age AgeGroup Gender Country
## 1 149    Neutral    NeutralF1       0  22    Adult Female      UK
## 2 149    Neutral    NeutralF2       0  22    Adult Female      UK
## 3 149    Neutral    NeutralF3       0  22    Adult Female      UK
## 4 149 Distressed DistressedF1       0  22    Adult Female      UK
## 5 149 Distressed DistressedF2       0  22    Adult Female      UK
## 6 149 Distressed DistressedF3       0  22    Adult Female      UK
MonkeyData$Expression=relevel(MonkeyData$Expression,"Neutral")
FullGLMM <- glmer(Correct ~ Expression + Country + Gender + Age + (1|Image
) + (1|ID), data = MonkeyData,family = "binomial")
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Country + Gender + Age + (1 | Image)
+
##     (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   2494.0   2539.7  -1239.0   2478.0     2248
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -5.2043 -0.6238  0.2938  0.6104  3.9684
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3147   0.561
##  Image  (Intercept) 1.1986   1.095
## Number of obs: 2256, groups:  ID, 94; Image, 24
##
## Fixed effects:
##                      Estimate Std. Error z value Pr(>|z|)
## (Intercept)          1.703999   0.434170   3.925 8.68e-05 ***
## ExpressionAggressive -1.568065   0.503518  -3.114  0.00184 **
## ExpressionDistressed -1.982965   0.493372  -4.019 5.84e-05 ***
## CountryUK            -0.170740   0.159157  -1.073  0.28337
## GenderMale            0.325071   0.189590   1.715  0.08642 .
## Age                  -0.004931   0.005021  -0.982  0.32599
```

```
## ---

MonkeyData$Expression=relevel(MonkeyData$Expression,"Distressed")
FullGLMM
<- glmer(Correct ~ Expression + Country + Gender + Age + (1|Image) + (1|ID
), data = MonkeyData,family = "binomial")
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Country + Gender + Age + (1 | Image)
+
##     (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   2494.0   2539.7  -1239.0   2478.0     2248
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -5.2043 -0.6238  0.2939  0.6104  3.9684
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3147   0.561
##  Image  (Intercept) 1.1986   1.095
## Number of obs: 2256, groups:  ID, 94; Image, 24
##
## Fixed effects:
##                      Estimate Std. Error z value Pr(>|z|)
## (Intercept)          -0.278967   0.432379  -0.645   0.5188
## ExpressionNeutral     1.982950   0.493341   4.019 5.83e-05 ***
## ExpressionAggressive  0.414886   0.504283   0.823   0.4107
## CountryUK            -0.170751   0.159157  -1.073   0.2833
## GenderMale            0.325068   0.189588   1.715   0.0864 .
## Age                  -0.004932   0.005021  -0.982   0.3260
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

MonkeyData$Gender=relevel(MonkeyData$Gender,"Male")
FullGLMM
<- glmer(Correct ~ Expression + Country + Gender + Age + (1|Image) + (1|ID
), data = MonkeyData,family = "binomial")
summary (FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Country + Gender + Age + (1 | Image)
+
##     (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   2494.0   2539.7  -1239.0   2478.0     2248
```

```
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -5.2044 -0.6238  0.2938  0.6104  3.9684
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3147   0.561
##  Image  (Intercept) 1.1986   1.095
## Number of obs: 2256, groups:  ID, 94; Image, 24
##
## Fixed effects:
##                      Estimate Std. Error z value Pr(>|z|)
## (Intercept)           0.046125   0.440856   0.105   0.9167
## ExpressionNeutral     1.982965   0.493422   4.019 5.85e-05 ***
## ExpressionAggressive  0.414889   0.504306   0.823   0.4107
## CountryUK            -0.170748   0.159159  -1.073   0.2834
## GenderFemale         -0.325071   0.189593  -1.715   0.0864 .
## Age                  -0.004931   0.005021  -0.982   0.3260
## ---

MonkeyData$Country=relevel(MonkeyData$Country,"UK")
FullGLMM
<- glmer(Correct ~ Expression + Country + Gender + Age + (1|Image) + (1|ID
), data = MonkeyData,family = "binomial")
summary(FullGLMM)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Country + Gender + Age + (1 | Image)
+
##     (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   2494.0   2539.7  -1239.0   2478.0     2248
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -5.2044 -0.6238  0.2938  0.6104  3.9684
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3147   0.561
##  Image  (Intercept) 1.1986   1.095
## Number of obs: 2256, groups:  ID, 94; Image, 24
##
## Fixed effects:
##                      Estimate Std. Error z value Pr(>|z|)
## (Intercept)           1.858350   0.452822   4.104 4.06e-05 ***
## ExpressionDistressed -1.982997   0.493382  -4.019 5.84e-05 ***
## ExpressionAggressive -1.568086   0.503527  -3.114  0.00184 **
## CountryARG            0.170756   0.159157   1.073  0.28333
## GenderFemale         -0.325079   0.189592  -1.715  0.08641 .
```

```
## Age                 -0.004931   0.005021  -0.982  0.32599
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
null <- lmer(Correct ~ 1 + (1 | ID), data = MonkeyData,REML = FALSE)
summary(null)
## Linear mixed model fit by maximum likelihood  ['lmerMod']
## Formula: Correct ~ 1 + (1 | ID)
##    Data: MonkeyData
##
##      AIC      BIC   logLik deviance df.resid
##   3240.3   3257.5  -1617.2   3234.3     2253
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.4411 -1.0818  0.7438  0.8875  1.2109
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  ID       (Intercept) 0.007313 0.08552
##  Residual             0.240005 0.48990
## Number of obs: 2256, groups:  ID, 94
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept)  0.55192    0.01357   40.67
anova(null, FullGLMM)
## Data: MonkeyData
## Models:
## null: Correct ~ 1 + (1 | ID)
## FullGLMM: Correct ~ Expression + Country + Gender + Age + (1 | Image)
+
## FullGLMM:     (1 | ID)
##          npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## null        3 3240.3 3257.5 -1617.2   3234.3
## FullGLMM    8 2494.0 2539.7 -1239.0   2478.0 756.36  5  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Full
<- glmer(Correct ~ Expression + Gender + Country + Age + Expression:Gender
 + Expression:Country + (1|Image) + (1|ID), data = MonkeyData,family
= "binomial")
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
control$checkConv, :
## Model failed to converge with max|grad| = 0.00302314 (tol = 0.002,
component 1)
summary(Full)
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: Correct ~ Expression + Gender + Country + Age +
Expression:Gender +
##     Expression:Country + (1 | Image) + (1 | ID)
##    Data: MonkeyData
```

```
##
##      AIC      BIC   logLik deviance df.resid
##   2495.0   2563.7  -1235.5   2471.0     2244
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -5.1374 -0.6249  0.2926  0.6153  4.4192
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  ID     (Intercept) 0.3168   0.5629
##  Image  (Intercept) 1.2387   1.1130
## Number of obs: 2256, groups:  ID, 94; Image, 24
##
## Fixed effects:
##                                    Estimate Std. Error z value
Pr(>|z|)
## (Intercept)                         1.803343   0.483901   3.727 0.000194
***
## ExpressionDistressed               -1.934831   0.559892  -3.456 0.000549
***
## ExpressionAggressive               -1.423657   0.579437  -2.457 0.014012
*
## GenderFemale                       -0.107582   0.264152  -0.407
0.683807
## CountryARG                         -0.067695   0.219549  -0.308
0.757827
## Age                                -0.005031   0.005038  -0.999
0.317981
## ExpressionDistressed:GenderFemale -0.153556   0.299563  -0.513
0.608230
## ExpressionAggressive:GenderFemale -0.531155   0.318225  -1.669 0.095094
.
## ExpressionDistressed:CountryARG    0.229178   0.248667   0.922
0.356724
## ExpressionAggressive:CountryARG    0.505894   0.262315   1.929 0.053784
.
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```